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RECORD OF DECISION

Tutu WellfieldSite

Anna's Retreat, St. Thomas , U.S. Virgin Islands

United States Environmental Protection Agency
Region II
New York, New York
July 1996

TUT 008 0736

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Tutu Wellfield Site

Anna's Retreat, St. Thomas, U.S. Virgin Islands

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) documents the U.S. Environmental Protection Agency's (EPA's) selection of the remedial action for the Tutu Wellfield Site (Site) in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. §9601 et seq. and to the extent practicable the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. An administrative record for the site, established pursuant to the NCP, 40 CFR 300.800, contains the documents that form the basis for EPA's selection of the remedial action (see Appendix III).

The U.S. Virgin Islands Department of Planning and Natural Resources (DPNR) has been consulted on the planned remedial action in accordance with CERCLA §121(f), 42 U.S.C. §9621(f), and it concurs with the selected remedy (see Appendix IV).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This operable unit is the only operable unit for the Site.

The principal threat at the site is posed by exposure to groundwater. The selected remedy addresses both groundwater and the source materials that may be acting as a reservoir for migration of contamination to groundwater. EPA has determined that these source materials constitute principal threat wastes. At the Tutu Wellfield Site, the principal threat wastes are surface and subsurface soil containing high concentrations of mobile contaminants of concern, and non-aqueous phase liquids (free product or NAPLs). Surface soils with non-mobile contaminants of low to moderate toxicity were determined to represent low-level threat wastes.

The major components of the selected remedy include the following:

SOIL REMEDIATION ALTERNATIVE (SRA 3/4)

- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which place limitations on property usage (e.g., for commercial or industrial use only);

- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which ensure that excavation or soil disturbance at any of the impacted areas will not occur in the future without full permit approval, proper worker-protection precautions, and air monitoring for potential fugitive emissions;

- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which prohibit the excavation, transportation and usage of soil or rock from impacted areas without EPA and DPNR approval;

- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which prevent permanently the removal or disturbance of bedrock at O'Henry Dry Cleaners and the Curriculum Center where dense nonaqueous phase liquids (DNAPLs) may be present in the subsurface.

The following remedial activities will take place at the affected properties:

<u>Texaco Tutu Service Station:</u>

- In-situ Soil Vapor Extraction (SVE) treatment of impacted soil;

- Catalytic oxidation for off-gas treatment.

<u>Esso Tutu Service Station:</u>

- In-situ SVE treatment and bioventing of impacted soil;

- Thermal oxidation for off-gas treatment.

<u>Four Winds Plaza/Western Auto:</u>

- Excavation and off-Site disposal of additional soils, if needed (to be determined after confirmatory sampling during remedial design).

<u>O'Henry Dry Cleaners:</u>

- In-situ SVE treatment of impacted soils, or, if such in-situ SVE proves to be ineffective, excavation and ex-situ SVE of impacted soils followed by the redepositing of the treated soil on-Site;
- In-situ SVE treatment in the unsaturated bedrock;
- Thermal oxidation for off-gas treatment.

Curriculum Center:

- Excavation of impacted soils, followed by either off-Site disposal, or ex-situ SVE and redepositing of the treated soil on-Site;
- In-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation, to remediate contaminated soils and/or rocks present in the unsaturated zone;
- Thermal oxidation for off-gas treatment.

The potential effectiveness of in-situ SVE will be determined during the pre-design phase. Additional source delineation is required prior to installation of the in-situ SVE treatment systems to insure the effectiveness of the remediation.

Buried 4-inch diameter PVC piping may be a potential source of contamination at the Four Winds Plaza, near the former Western Auto underground storage tank area. Additional investigation during the pre-design phase will be conducted to determine the need for remedial work in the area of Four Winds Plaza. Western Auto removed their underground storage tank and paved the area with a concrete cap in August 1994. Confirmatory sampling of the tank grave area will be completed to confirm that no residual contaminated soil above the cleanup levels (SSLs) has been left in-place. If such contaminated soil is found to be present, it will be excavated and disposed of off-Site.

GROUNDWATER REMEDIATION ALTERNATIVE (GRA 4)

- Efforts will be made to have existing domestic and commercial wells within the confines of the groundwater plume decommissioned if these wells are determined to interfere with the operation of the groundwater pump and treat system that will be installed as part of this remedial action. During the remedial design it will be determined which wells would interfere with this remedial action and which wells would continue to operate as they may enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.

- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought to prohibit unauthorized use of groundwater or the installation of new wells. Authorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.

- Implement Source Control Programs (consisting of installation and operation of extraction wells and air strippers) at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facilities.

- Install groundwater recovery wells for hydraulic control of plume migration. The proposed containment program will include the installation of three recovery wells (RW-1, RW-2, and RW-3) strategically placed in an effort to hydraulically contain plume migration. (See Figure 5)

- Install two groundwater recovery wells (RW-4 and RW-5) for hydraulic control of chlorinated VOC contaminant sources. The source containment will provide hydraulic barriers around source areas, allowing the reduction of contaminants in other parts of the aquifer and potentially reducing the time needed to reach Maximum Contaminant Levels (MCLs). (See Figure 5)

- Construct a central groundwater treatment facility with a total flow capacity of 100 gpm. Water will be treated to surface water criteria for discharge to the storm sewer near the O'Henry Dry Cleaners facility leading to Turpentine Run or treated to MCLs for distribution for potable purposes. EPA, in consultation with the Virgin Islands Government, will choose one of these two options during the remedial design phase. If a decision is made to treat the water to surface water criteria (not to MCLs), then water will continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rain water to cisterns and trucking water by tanker truck).

- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program will include the sampling approximately 15 wells at or near the plume boundary for VOCs and base neutrals and acids (BNAs), and would last for the duration of the remedial action and O&M (estimated, for costing purposes, to be approximately 30 years).

- Natural attenuation of low concentration contaminants at the plume edges and downgradient of RW-2 and RW-3.

Various potable use options for with respect to the treated groundwater are as follows:

- connect to the existing Water and Power Authority water main;
- truck the treated water to the impacted residences within the plume area;
- install a water distribution system from the central treatment facility to the impacted residences within the plume area.

EPA, in consultation with the Virgin Islands Government, will chose one of these options during the remedial design phase. Additional field work will be required during the pre-design stage prior to implementation of this remedy. Groundwater extraction system design will be based on field and aquifer testing and groundwater modelling. A wetlands assessment may be required if the groundwater modelling shows an adverse effect from discharge of treated water to the wetlands.

DECLARATION OF STATUTORY DETERMINATIONS

The selected remedy meets the requirements for remedial actions set forth in CERCLA §121, 42 U.S.C. §9621: (1) it is protective of human health and the environment; (2) it attains a level or standard of control of the hazardous substances, pollutants and contaminants, which at least attains the legally applicable or relevant and appropriate requirements (ARARs) under federal and territorial laws (subject to the discussion of DNAPL below); (3) it is cost-effective; (4) it utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable; and (5) it satisfies the statutory preference for remedies that employ treatment to reduce the toxicity, mobility, or volume of the hazardous substances, pollutants or contaminants at a site.

EPA recognizes that the restoration of certain portions of the Tutu aquifer to MCLs may be technically impracticable, due to the high probability that DNAPLs are present in the unsaturated and/or saturated soils and fractured bedrock at the Curriculum Center and O'Henry Dry Cleaners properties. If DNAPLs are present in either of these areas, there are technical limitations, from an engineering perspective, which may make it impracticable to find and remove all the DNAPLs from these properties. This will be especially true if DNAPLs are present in the complex fractured bedrock, either above or below the water table. Because DNAPL contributes to dissolved phase groundwater contamination, restoration of groundwater in the vicinity of the Curriculum Center and O'Henry Dry Cleaners may be technically impracticable. Therefore, a waiver of MCLs ultimately may be required for the Curriculum Center and O'Henry Dry Cleaners properties groundwater due to the presence of DNAPLs.

A five-year review of the remedial action pursuant to CERCLA §121(c), 42 U.S.C. §9621(c), will be necessary, because this remedy will result in hazardous substances remaining on-site above health-based levels.

William [signature]
Jeanne M. Fox
Regional Administrator

8/5/91
Date

RECORD OF DECISION FACT SHEET
EPA REGION II

Site:

Site name: Tutu Wellfield Site

Site location: Anna's Retreat, St. Thomas, U.S. Virgin Islands

HRS score: 50.00, August 21, 1991

Listed on the NPL: September 29, 1995

Site ID #: VID982272569

Record of Decision:

Date signed: July , 1996

Selected remedy: Soil Vapor Extraction for impacted soil and plume and source containment/treatment for contaminated groundwater

Estimated Construction Completion: 9/99

Capital cost: Soil: $ 1.5 million ; Groundwater: $ 3.2 million (in 1996 dollars)

Annual O & M cost: Soil: $ 120K; Groundwater: $ 314K

Present-worth cost: (5 % discount rate for 30 years) Soil: $ 3.6 million
Groundwater: $ 9.0 million

Lead:

PRP-Lead Site

Primary Contact: Caroline Kwan, (212) 637-4275

Secondary Contact: Melvin Hauptman, (212) 637-3952

Main PRPs: Refer to the attached PRPs list

Waste:

Waste type: chlorinated solvents, benzene, toluene, ethylbenzene, xylene

Waste origin: Underground storage tanks, dry cleaner, textile company

Estimated waste quantity: N/A

Contaminated media: Soil and groundwater

Tutu Wellfield Site Potentially Responsible Parties

1. Texaco Caribbean, Inc.
2. Virgin Islands Dept. of Education
3. Four Winds Plaza Partnership
4. L'Henri, Inc.
5. Andreas Gal
6. Paul Lazare
7. Ramsay Motors, Inc.
8. Esso Standard Oil, S.A., Ltd.
9. Western Auto Supply Company
10. Francois Realty Company

RECORD OF DECISION
DECISION SUMMARY

Tutu Wellfield Site

Anna's Retreat, St. Thomas, U.S. Virgin Islands

United States Environmental Protection Agency
Region II
New York, New York
July 1996

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ATTACHMENTS

SITE NAME, LOCATION AND DESCRIPTION

The Tutu Wellfield Site is located in the upper Turpentine Run basin in eastern central St. Thomas, U.S. Virgin Islands in the Estate Anna's Retreat section of the island. A Site Location Map is provided in Figure 1. The Site is surrounded by hills to the west, north, and east. Various commercial establishments, including operating gas stations, car repair shops, a shopping center, a dry cleaner, fast food restaurants, etc. are located along the major roads in the area, within the boundaries of the Site. Private homes and multi-family housing, such as the Virgin Islands Housing Authority (VIHA) projects, occupy the less heavily traveled roads (see Figure 2).

The Turpentine Run Basin trends north-south and is surrounded by relatively steep slopes. Other valleys in the area, such as the valley south of the Virgin Islands Housing Authority (VIHA) and the Curriculum Center (along which Route 484 runs), and the valley just west of the Benjamin Oliver School, trend northeast-southwest. Land surface elevations along the Turpentine Run decrease from about 200 feet above mean sea level (msl) at the northern end of the site to approximately 100 feet above msl at the southern end of the site.

The Turpentine Run is an intermittent stream that traverses the length of the basin. In the upper Turpentine Run Basin, the stream generally flows from north to south following Route 38. In the lower basin, the stream turns around Mt. Zion and then trends southeast. Surface-water runoff is collected in a storm-water catchment system. Storm water and secondary sewage eventually discharge to the Turpentine Run. The Turpentine Run is partially channelized and ultimately discharges into Mangrove Lagoon and the Caribbean Sea. There is a forested wetland system located at the southeastern portion of the Site on Highway 32.

According to the most recent census data (U.S. Census Bureau 1990), approximately 9,100 people live in the Tutu subdistrict of St. Thomas. The Tutu subdistrict, also known as Anna's Retreat, covers 1.5 square miles (4 square kilometers) in the central-eastern part of St. Thomas. Tutu is second to Charlotte Amalie in population density on St. Thomas and contains approximately 20 percent of the island's population.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

In July 1987, Mr. Tillett, owner of Tillett Gardens, contacted the USVI Department of Planning and Natural Resources (DPNR) regarding an odor emanating from his well water. DPNR requested EPA assistance in sampling groundwater at the Tillett and other wells located in the Turpentine Run Basin. The analytical results from the sampling indicated that these wells contained elevated levels of chlorinated volatile organic compounds (VOCs) and gasoline constituents. Based on groundwater sampling results, DPNR closed 13 commercial and five private wells in the Tutu area between July and September 1987. Many of these wells are currently in use for non-potable purposes. After the initial sampling of six supply wells in July 1987, EPA's sampling and screening investigation was expanded to include 24 supply wells beginning in August 1987. Analyses for benzene, toluene, perchloroethylene (PCE), trichloroethylene (TCE), and 1,2-trans dichloroethylene (DCE) were performed using a Photovac field gas chromatograph (GC) for samples collected monthly from August through December 1987.

The October 1987 groundwater samples were also analyzed for Hazardous Substance List (HSL) VOCs, base neutral and acid extractable compounds (BNAs), and metals by USEPA-contracted laboratories. Fourteen of the 24 supply wells sampled during this sampling event had elevated values of VOCs including trans-1,2-DCE, TCE, PCE, toluene, benzene, and methyl tertiary-butyl ether (MTBE). The October 1987 sampling event confirmed the August 1987 groundwater sampling results and also detected arsenic (15 part per billion (ppb)), selenium (915 ppb), and zinc (460 ppb) in some of the wells sampled. The highest reported contaminant concentration during the October 1987 sampling event (excluding methylene chloride, which is a common laboratory contaminant) was 2,000 ppb of PCE in the Harvey Supply Well.

In January 1988, EPA initiated a limited Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal action that included the decontamination and cleaning of five residential cisterns contaminated by hazardous substances, modification of plumbing, delivery of water by tank trucks as a temporary alternative water supply, and implementation of a well-water monitoring program.

Laboratory analysis for HSL VOCs, BNAs, metals, and cyanide was performed on 18 supply well samples collected in November 1988. EPA also sampled and analyzed 123 cisterns that were filled with groundwater pumped from supply wells located in this area. Three of the cisterns contained total VOCs in excess of 1,000 ppb.

From 1988 to 1990, EPA sent Information Request letters under Section 104 of CERCLA and 3007 of the Resource, Conservation and Recovery Act (RCRA) to a number of businesses regarding operations and waste disposal at these businesses. Based on the findings of these requests, EPA issued a Unilateral Administrative Order (AO) under CERCLA and RCRA on March 22, 1990 to Texaco, Esso, and O'Henry Dry Cleaners. This AO required these parties to implement EPA's well-water monitoring program, to provide potable water to residents with contaminated well water, and to coordinate and design plans to connect those residents to the local public water supply. After re-evaluation of the impracticability of connecting these residents to the public water line by the PRPs due to the intermittent shut-off of the public water supply by the Water and Power Authority during drought seasons, an escrow account was set up with the PRPs in February 1994 to provide trucked water to impacted residents in the Tutu Wellfield Site until their wells are returned to potable use. These parties have been fully complying with this AO since its issuance.

In June 1989, EPA sent Texaco and Esso a draft Administrative Order on Consent (AOC) pursuant to the authority of CERCLA and RCRA requiring the implementation of a

Remedial Investigation (RI) and Feasibility Study (FS) in the Tutu area. Texaco and Esso formed the Tutu Environmental Investigation Committee (TEIC) in March 1990 and retained Geraghty & Miller to prepare a work plan for, and to implement, the RI and FS. A final AOC was entered into by EPA, Texaco, and Esso on February 19, 1992.

EPA proposed the Tutu Wellfield Site for inclusion on the National Priorities List (NPL) on February 1, 1992. The Site became finalized on the NPL on September 29, 1995.

In March 1995, EPA issued a Consent Order to L'Henri, Inc. (O' Henry Dry Cleaners) for soil cleanup. Pursuant to that Order, approximately 700 cubic feet of PCE contaminated soil was removed at the O'Henry Dry Cleaners property and treated on site by soil venting.

Since 1993, EPA has identified a number of additional potentially responsible parties (PRPs) with respect to the Site including, but not unlimited to, Francis Realty Company, the Virgin Islands Dept. of Education, Four Winds Plaza Partnership, Andreas Gal and Paul Lazare, Ramsay Motors, Inc., and Western Auto Supply Company.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI report, FS report, and the Proposed Plan for the Site were originally released to the public for comment on August 23, 1995. However, due to the arrival of Hurricane Marilyn in September 1995, and the resulting devastation in St. Thomas, the public meeting was postponed for six months. The Proposed Plan was re-released to the public for comment on February 12, 1996. The RI report, FS report and the Proposed Plan were made available to the public in the administrative record file at the EPA Docket Room in Region II, New York and the EPA Caribbean Field Office (CFO) in San Juan, Puerto Rico. Information repositories are also located at the Department of Education Curriculum Center, Anna's Retreat, St. Thomas, U.S.V.I. and the Department of Planning and Natural Resources Environmental Protection Division, Wheatley Shopping Center II, St. Thomas, U.S.V.I. The notice of availability for the above-referenced documents was published in the Virgin Islands Daily News on February 10 and 11, 1996, and the Virgin Islands Weekly Journal on February 16, 1996. The public comment period on these documents was held from February 12, 1996 to March 13, 1996.

On March 5, 1996, EPA conducted a public meeting at the Department of Education Curriculum Center in Anna's Retreat to inform local officials and interested citizens about the Superfund process, to review current and planned remedial activities at the Site, and to respond to any questions from area residents and other attendees.

Responses to the comments received at the public meeting and in writing during the public comment period are included in the Responsiveness Summary (see Appendix V).

SCOPE AND ROLE OF OPERABLE UNIT

This is the first and only operable unit at the Site.

The objectives of the remedial investigation and response actions at the Tutu Wellfield Site are: 1) to protect the public from health risks associated with the use of contaminated groundwater; 2) to contain the spread of contamination in the aquifer, and, if possible, restore the aquifer to drinking water quality; and 3) to address contaminated soils, which represent a source of the groundwater contamination.

Early response actions taken by EPA and DPNR to mitigate risks to human health from Site related contaminants included the closing of contaminated residential and commercial supply wells in 1987 and the cleaning of residential cisterns in 1988. In addition, leaking underground storage tanks were removed at the two gas stations in 1988 and 1989 to prevent the further release of petroleum compounds to groundwater from the source area.

SUMMARY OF SITE CHARACTERISTICS

Remedial investigation/feasibility study (RI/FS) activities were conducted at the Tutu Wellfield Site, with EPA oversight, from 1992 to 1994. The overall objectives of the RI were: 1) to identify and characterize the potential sources of groundwater contamination, 2) to determine the horizontal and vertical extent of contamination, 3) to determine the rate and direction of contaminant transport, and 4) to determine the potential migration pathways for petroleum hydrocarbons and chlorinated VOCs in soil and groundwater at the Site.

The RI was conducted in two phases. Phase I focused on determining the extent of groundwater contamination and on identifying existing sources of the groundwater contamination. Based on the Phase I findings, the groundwater investigation was expanded to the south in Phase II. In addition, during Phase II RI, available soil data from various PRP investigations was compiled for each property that had been identified as a potential source area during Phase I. The following properties were investigated and/or inspected during the Phase II soil investigation:

* VIHA
* Curriculum Center
* Ramsay Motors
* Antilles Auto Parts
* Texaco Tutu Services Station
* Tillett Gardens
* Four Winds Plaza
* Former Western Auto
* Esso Tutu Service Station

* O'Henry Dry Cleaner
* Fire Station
* Vitelco
* God of Holiness Church
* Lutheran Church
* Assembly of God Church

Concurrent with the RI activities, commercial and residential supply wells in the Tutu valley were sampled on a quarterly basis.

HYDROGEOLOGY

The Tutu Wellfield Site is underlain by bedrock consisting mainly of andesitic, volcanoclastic tuffs, breccias, and conglomerates of the Water Island and Louisenhoj Formations. The overburden consists of a thin soil layer and alluvial deposits which range in thickness from less than 2 feet on the valley slopes to approximately 30 feet in the axis of the valley.

The primary aquifer beneath the study area is the fractured volcanic bedrock. Groundwater is stored and transmitted through fracture sets along major lineaments (faults, joints, and bedding planes). Groundwater flow is to the south and southeast from the highland areas (recharge zones) towards the lower Turpentine Run basin (discharge zone). The surficial alluvial deposits, where saturated, form a secondary aquifer of lesser significance due to their limited thickness and lateral extent. The alluvial aquifer is in direct hydraulic communication with the bedrock aquifer, although local perched water conditions may exist at the top of bedrock.

The terms "shallow" (also referred to as overburden) and "deep" bedrock zones have been used in the remedial investigation of the Tutu Wellfield Site. The terminology refers to the screened depths of monitoring and supply wells which have been installed throughout the Tutu Valley. The "shallow" bedrock zone is defined by wells screened across the water table. The "deep" bedrock zone is defined by deeper monitoring wells (generally screened 30 to 50 feet below the water table) and by existing supply wells (deep, open boreholes drilled to depths of 200 to 300 feet below ground surface).

SOIL INVESTIGATIONS AND RESULTS

During the Phase I and II RI, surface and subsurface soil samples were collected from borings and monitoring well boreholes. Soil quality data was collected from 15 properties in the project study area to identify impacted soils.

Soil samples collected during the RI were analyzed for target compound list (TCL) VOCs and base neutral acids (BNAs), target analyte list (TAL) metals, cyanide, and petroleum hydrocarbons. Site-specific, vadose zone modeling-derived soil screening levels (SSLs) were used as guidance values to identify soil areas that might require remediation based on the potential for leaching of contaminants into groundwater. Further explanation on how the SSLs were derived can be found in the section of the Selection of Site Cleanup Levels. The properties identified with soil concentrations above the SSLs were placed into two categories: 1) properties with soil impacted by chlorinated VOCs, and 2) properties with soil impacted by petroleum-related compounds including benzene, toluene, ethylbenzene, and xylene (BTEX).

Based on the exceedance of SSLs for chlorinated constituents, three properties were identified as having chlorinated VOCs in soil at high enough concentrations to potentially impact groundwater. The principal chlorinated VOCs detected include PCE, TCE, 1,2-DCE, 1,1,1-trichloroethane (1,1,1-TCA), and 1,1-dichloroethane (1,1-DCA). In addition, five properties were identified as having BTEX compounds in soil.

<u>**Chlorinated VOCs in Soil**</u>

Three properties were identified as having significant chlorinated VOC impact to soil, based on exceedance of EPA's site-specific SSLs: 1) the Curriculum Center, 2) Esso Tutu Service Station, and 3) O'Henry Dry Cleaners. (see Table 1)

At the **Curriculum Center**, approximately 3 to 1800 micrograms per kilogram (ug/kg) of PCE was detected in eight samples at the north-central side of the main building in the vicinity of the former discharge pipe and presumed former waste pit. TCE was detected in four samples at concentrations from 1 to 130 ug/kg. One chlorinated VOC, 1,1,1-TCA, was detected above the EPA's SSLs. It is suspected that higher concentrations of chlorinated VOCs may be present in the soil beneath the building or in the unsaturated bedrock. The elevated concentrations of chlorinated VOCs in groundwater adjacent to and immediately downgradient of the Curriculum Center indicate a high probability that pure product is present in the unsaturated zone as dense non-aqueous phase liquid (DNAPL) at the Curriculum Center.

At the **Esso Tutu Service Station**, PCE, TCE, 1,1,1-TCA, 1,2-DCE, and 1,1-DCA were detected above EPA's SSLs in four samples at concentrations ranging from 44 to 3,200 ug/kg. These chlorinated VOCs were detected at the western portion of the property, near the north oil/water separator.

PCE was found in the vicinity of the **O'Henry Dry Cleaners** above EPA's SSLs in the southwestern portion of the property. The range of PCE concentration was 200 to 440,000 ug/kg. In addition, there is a potential for DNAPL to be present in the subsurface soils near the O'Henry Dry Cleaners since historical concentrations (up to 1,500 part per billion (ppb)) of PCE in groundwater in adjacent wells have exceeded 1 percent of the solubility of PCE.

BTEX in Soil

The site-specific SSLs for BTEX compounds were exceeded at five properties: 1) the Curriculum Center (formerly the Laga Building), 2) Ramsay Motors, 3) Texaco Tutu Service Station, 4) Western Auto, and 5) Esso Tutu Service Station. (see Table 1)

At the northeast corner of the **Curriculum Center**, in an area where a sink from the paint shop drain discharged to the ground, BTEX compounds exceeded EPA's SSLs in two surface soil samples. The individual BTEX compounds ranged from benzene at 2,700 ug/kg to toluene at 500,000 ug/kg.

Benzene and ethylbenzene were detected in the vicinity of the underground storage tank (UST) at the **Ramsay Motors property** at levels above their respective EPA SSLs; benzene at 17 ug/kg and ethylbenzene at 190 ug/kg and 290 ug/kg.

At the **Texaco Tutu Service Station**, BTEX compounds were found in the vicinity of the former USTs and at the oil/water separator at concentrations exceeding EPA's SSLs. Results ranged from 69 ug/kg for benzene to 630 ug/kg for ethylbenzene.

At the **Western Auto** facility, BTEX constituents were detected in 21 soil samples at concentrations above EPA's SSLs. All individual BTEX constituents exceeded EPA's SSLs. These results ranged from toluene and ethylbenzene at 16 ug/kg and xylene at 34,000 ug/kg. A shallow gravel layer underlying the pavement in this area also contained visible stained oil. The impacted soil was located adjacent to an underground storage tank, which was removed in August 1994.

At the **Esso Tutu Service Station**, BTEX compounds exceeded EPA's SSLs in 16 samples near the gasoline pump island, the north oil/water separator, and the former UST excavation. Individual BTEX concentrations above EPA's SSLs ranged from 26 ug/kg of ethylbenzene to 540,000 ug/kg of xylenes.

PCBs in Soil

At the Tillett Gardens property, no chlorinated VOCs or BTEX constituents were detected above screening levels in the Site soil. However, elevated concentrations (120,000 ug/kg) of the PCB Aroclor 1242 were detected in one surface sample in 1988. Because this sample concentration resulted in unacceptable risks to human health from direct exposure, EPA collected confirmatory samples from the affected area in August 1995 to delineate the extent of impacted soils. PCBs were not detected in any of the confirmatory samples, indicating that PCBs are no longer a concern at this property.

GROUNDWATER INVESTIGATIONS AND RESULTS

During the Phase I RI, groundwater samples were collected from 19 monitoring wells in the Tutu area. During the Phase II RI, the study was expanded to the south and a comprehensive round of groundwater samples was collected from 51 monitoring wells and 15 supply wells in the Tutu Valley. (see Figure 3) Theses samples were analyzed for VOCs, BNAs, metals, and various inorganic water quality parameters. In addition, eight rounds of groundwater supply well samples were collected and analyzed during the RI. The groundwater sampling result indicate the presence of four main plumes of contamination at the Tutu Wellfield Site: two chlorinated VOC plumes and two BTEX plumes.

Chlorinated VOC Plumes

The two chlorinated VOC plumes are referred to as the northern and southern VOC plumes because of their locations (See Figure 4). In general, the concentrations within these plumes, in both the shallow and deep zones, appear to be decreasing since 1992, with the exception of the northern chlorinated plume in the immediate vicinity of the Curriculum Center. Concentrations of VOCs in the northern part of the north plume have not decreased with time, nor have the shape or general extent of VOC contamination changed in this area, indicating that the northern chlorinated VOC plume is relatively stable. This stability suggests that there may be a continuing source of VOCs to groundwater in the vicinity of the Curriculum Center.

The shallow northern chlorinated VOC plume, which originates near the Curriculum Center, extends approximately 1,600 feet south, in the direction of the groundwater flow, to a point just southeast of Four Winds Plaza and is approximately 500 feet wide. The highest concentrations of total chlorinated VOCs occur in shallow zone monitoring wells, where chlorinated VOC concentrations greater than 1,000 parts per billion (ppb) were detected.

The principal chlorinated VOCs detected in the northern plume are 1,2-DCE, PCE and TCE. Vinyl chloride was also detected in wells near the Curriculum Center. The maximum concentrations of these hazardous substances detected in groundwater during the RI were 1,2-DCE at 2,100 ppb, vinyl chloride at 1,300 ppb, PCE at 360 ppb and TCE at 78 ppb. All these hazardous substances exceed the Safe Drinking Water Act Maximum Contaminants Levels (MCLs) for drinking water. The MCLs for 1,2-DCE, PCE, TCE and vinyl chloride are 70, 5, 5 and 2 ppb, respectively. Historically, the concentration of PCE in the Tillett supply well, located downgradient of the Curriculum Center, has been reported up to 2,040 ppb, which exceeds 1 percent of the solubility of PCE. Dense non-aqueous phase liquids (DNAPLs) are therefore suspected to be present in this vicinity. The maximum concentrations of 1,1-DCE and vinyl chloride also strongly suggest the presence of chlorinated DNAPL in the vicinity of the Curriculum Center. (see Table 2)

In the southern part of the northern chlorinated VOC plume, south of Tillett Gardens, VOC concentrations increase with depth. Concentrations in this part of the plume, however, are generally lower than they are near the Curriculum Center. The highest concentrations of chlorinated VOCs in this part of the plume were PCE at 140 ppb, 1,2-DCE at 100 ppb and TCE at 33 ppb.

The southern VOC plume originates near the O'Henry Dry Cleaners and extends southeast approximately 4,000 feet and it is approximately 800 feet wide. In the shallow zone, the highest total concentration of VOCs detected in 1994 was 181 ppb in a monitoring well just downgradient of O'Henry Dry Cleaners. In the deep zone, total chlorinated VOCs were detected above 100 ppb in several private supply wells. The chlorinated VOCs detected in the southern plume consist primarily of PCE, TCE, and 1,2-DCE above MCLs, with PCE contributing about 75 percent of the total chlorinated VOCs detected in wells near the O'Henry Dry Cleaners. The historical presence of PCE at concentrations in excess of 1,500 ppb in wells adjacent to the O'Henry facility suggests the possible presence of DNAPLs in the saturated zone.

BTEX plumes

The shallow BTEX plume located near the Texaco Tutu Service Station is approximately 400 feet long from north to south and approximately 200 feet wide from east to west. In the deep zone, it is approximately 300 feet by 130 feet in areal extent. The plume is elongated in the direction of shallow groundwater flow and appears to have migrated past the Tillett Supply Well since 1982. The maximum concentration of benzene is 21,000 ppb, ethylbenzene is 3,700 ppb and xylenes is 18,000 ppb. The MCLs for benzene is 5 ppb, ethylbenzene is 700 ppb and total xylenes is 10,000 ppb. These concentrations exceed the MCLs. (see Figure 4)

The shallow BTEX plume located near the Esso Tutu Service Station, as identified by existing monitoring wells, measures approximately 250 feet by 175 feet. The maximum concentration of benzene detected at this location is 10,000 ppb, ethylbenzene is 4,100 ppb and xylenes is 22,000 ppb. The concentrations exceed the MCLs.

Direct observations of floating product and sheens in some monitoring wells at the Esso Tutu and Texaco Tutu Service Stations confirmed the presence of light non-aqueous phase liquids (LNAPL).

CONTAMINANT MIGRATION PATHWAYS

Contaminants may migrate through environmental media at the Tutu Wellfield Site via several mechanisms. First, the constituent-containing **soils** can act as a source of constituents to other environmental media. Second, migration into **air** may occur via volatilization or fugitive dust emissions. Third, migration into **groundwater** may occur by direct vertical migration of contaminants or by percolation of infiltrating rain water that dissolves the contaminants of concern. Fourth, transport into **surface water** (Turpentine Run) may occur via groundwater discharge.

Several factors influence the significance of each of these migration or transport pathways. These factors include the properties of the environmental media, the constituent concentration, and the physical and chemical properties of the constituent itself.

SUMMARY OF SITE RISKS

Based upon the results of the RI, a baseline risk assessment was conducted to estimate the risks associated with current and future Site conditions. The baseline risk assessment estimates the human health and ecological risks which could result from exposure to chemical contamination at the Tutu Wellfield Site if no remedial action were taken.

Risk to human health is defined as the likelihood that people living, working, or playing on or near the Site may experience health problems as a result of their exposure to contaminants from the Site. The ecological risk evaluation appraises actual or potential effects of contaminants on plants and animals.

HUMAN HEALTH RISK ASSESSMENT

A four-step process is used for assessing Site-related human health risks for a reasonable maximum exposure scenario:

- Hazard Identifications – identifies the chemical contaminants of concern at the Site based on several factors such as toxicity, frequency of occurrence, and concentration.

- Exposure Assessment – estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (e.g., ingesting contaminated well-water) by which humans are potentially exposed.

- Toxicity Assessment – determines the type of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response).

- Risk Characterization – summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of Site-related risks.

Hazard Identifications- The baseline risk assessment began with selecting chemical contaminants of concern which would be representative of Site risks. These contaminants included VOCs, semivolatile organic compounds (SVOCs), and inorganics. Several of these contaminants, such as benzene, tetrachloroethane, and vinyl chloride, which are VOCs; benzo(a)pyrene and benzo(b)fluoranthene, which are SVOCs; and arsenic and chromium VI, which are inorganics, are either known human carcinogens or are known to cause cancer in laboratory animals and are probable human carcinogens. The summary of the contaminants of concern in sampled matrices is listed in **Tables 3** and **4** for human health and the environmental receptors, respectively.

Exposure Assessment- The baseline risk assessment evaluated the health effects which could result from exposure to chemical contamination as a result of ingestion, dermal contact, inhalation of particulates, and inhalation of VOCs. Exposure scenarios involving surface soil, subsurface soil, and groundwater were quantitatively addressed for three receptor groups: 1) current and potential future residents in the Tillett Gardens and Art Center area; 2) current and potential future Site workers (employees) at the Fire Department, Texaco gas station, Antilles Auto Parts and Ramsay Motor Co., Curriculum Center Building, and O'Henry Dry Cleaners and Liquor Barn; and 3) potential future construction workers. Only the Tillett Gardens and Art Center area was selected for quantitative evaluation for the construction worker scenario based on the chemical concentrations detected, toxicity and the calculated residential risks.

A total of seven exposure pathways were evaluated under possible on-site current and future land-use conditions. Potential exposure pathways are listed in **Table 5**. The reasonable maximum exposure was evaluated.

Toxicity Assessment

Under current EPA guidelines, the likelihood of carcinogenic (cancer-causing) and noncarcinogenic effects due to exposure to Site chemicals are considered separately. It was assumed that the toxic effects of the site-related chemicals would be additive. Thus, carcinogenic and noncarcinogenic risks associated with exposures to individual compounds of concern were summed to indicate the potential risks associated with mixtures of potential carcinogens and noncarcinogens, respectively.

Noncarcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected contaminant intakes and safe levels of intake (Reference Doses). Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects. RfDs, which are expressed in units of milligrams/kilogram-day (mg/kg-day), are estimates of daily exposure levels for humans which are thought to be safe over a lifetime. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) are compared to the RfD to derive the hazard quotient for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds across all media that impact a particular receptor population. The RfDs for the compounds of concern at the Site are presented in **Table 6**.

Potential carcinogenic risks were evaluated using the cancer slope factors developed by EPA for the contaminants of concern. Cancer slope factors (SFs) have been developed by EPA's Carcinogenic Risk Assessment Verification Endeavor for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes the underestimation of the risk highly unlikely. The SF for the compounds of concern are presented in **Table 7.**

For known or suspected carcinogens, EPA considers excess upper-bound individual lifetime cancer risks of between 10^{-4} to 10^{-6} to be acceptable. This level indicates that an individual has not greater than a one in ten thousand to one in a million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year period under specific exposure conditions at the site. For non-carcinogenic health effects, EPA considers that a hazard index greater than 1.0 indicates a potential for non-carcinogenic health effects to occur as a result of Site-related exposures.

The calculated carcinogenic risks and non-carcinogenic hazards for the exposure pathways and receptor groups evaluated in the Risk Assessment are summarized below. **Table 8** shows carcinogenic risks, combined across all pathways for each receptor group. No surface or subsurface soil pathways exceeded the target carcinogenic risk range for any current or future receptor group. However, hypothetical future exposure to Site contaminants in the groundwater by area residents (adults and children) and Site workers results in carcinogenic risks exceeding EPA's target risk range. The risks were primarily attributed to PCE and vinyl chloride. **Table 9** shows the calculated non-carcinogenic hazard index values, combined across pathways, for each receptor group. For soils, the only exposure that exceeded the hazard index of 1.0 was for ingestion or inhalation of surface soils by children residents in the Tillett Gardens area. The hazard was primarily due to manganese concentrations, which were within the range of Site background manganese values. The HI for ingestion of Site groundwater was exceeded for all receptor groups. The hazards were attributed to 1,2-DCE, PCE, antimony, manganese and vanadium.

Current and Potential Future Residents (Tillett Gardens and Art Center area):

The baseline human health risk assessment for the Tutu Wellfield Site was completed in 1994. The conclusion of the assessment indicated that residential exposure to surface soils in the Tillett Gardens and Art Center area showed carcinogenic risks in exceedance of the upper-bound of the target range. These risks were due largely to PCB Aroclor 1242 which had been reported on surface soil samples collected in 1988 by EPA's contractor. In August 1995, EPA conducted a confirmatory soil sampling at the Tillett Gardens and Art Center. These soil samples were analyzed for VOCs and PCBs. No PCBs were detected in any of the samples. Therefore, EPA recalculated the surface soil risk for carcinogenic risks to the current and future residents at the Tillett Gardens and Art Center area using the new data. The revised risk calculation is reflected below:

Surface soil risk calculations show that carcinogenic risks to current or future residents at the Tillett Gardens and Art Center area are within the EPA target risk range of 10^{-4} to 10^{-6}. The individual pathway and receptor risks are 8.2E-06 (adult ingestion), 5.5E-07 (adult inhalation), 1.9E-5 (child ingestion), and 6.4E-07 (child inhalation) **(Table 8)**. The 30-year combined risk for adult + child is 2.9E-05. These risks were solely attributed to arsenic. Dermal contact risks were evaluated qualitatively because dermal absorption factors were not available for Contaminants of Concern (COCs). For non-carcinogenic effect, the total hazard index for the child ingestion and inhalation of surface soil routes of exposure was 6.1, which is above the hazard index of 1.0 **(Table 9)**. This risk was attributable to manganese. No adult hazard index values exceeded 1.0.

Subsurface soil was found to pose an acceptable risk to current or future residents; neither the dermal contact route nor the inhalation of particulates route resulted in carcinogenic risks of hazard index values above current federal guidelines.

Groundwater was found to pose an unacceptable risk to future residents for the ingestion route of exposure. The ingestion route showed a carcinogenic risk for adults of 6×10^{-4}, which is greater than the upper-bound of the acceptable risk range. The adult hazard index was 29 and the child hazard index was 67.

Current and Potential Future Site Workers (Employees) in Target Business

Surface soil and **subsurface soil** were found to pose an acceptable risk to current and future site workers for the ingestion, dermal contact, inhalation of particulates, and inhalation of VOCs routes. None of these routes resulted in carcinogenic risks or hazard index values above current federal guidelines.

Groundwater was found to pose an unacceptable risk to future site workers via the ingestion route. The carcinogenic risk of about 2×10^{-4} exceeds the upper-bound of the target risk range, and the hazard index of 10 exceeds the acceptable level of 1.0. The estimated risks are primarily due to the cumulative effects of tetrachloroethene and vinyl chloride which, when combined, contributed 83 percent to total carcinogenic risk calculations.

Potential Future Construction Workers:

Surface soil and **subsurface soil** were found to pose an acceptable risk to human health for the ingestion, dermal contact, and inhalation of particulates routes of exposure evaluated. None of these routes resulted in carcinogenic risks or hazard index values above EPA guidelines.

Groundwater was found to pose an unacceptable hazard to future construction workers for noncarcinogens for the ingestion route. Although the carcinogenic risk did not exceed the current federal guidelines, the hazard index of 9 exceeds the target level of 1.0.

Conclusions

The baseline risk assessment indicated that groundwater poses unacceptable risks of exposure to carcinogens and/or noncarcinogens for all three receptor groups. The only unacceptable risk from exposure to site soils was limited to one property (Tillett Gardens) where the noncarcinogenic hazard index for surface soils was exceeded for the residential scenario.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the preferred alternative or one of the other active measures considered, may represent a current or potential threat to public health, welfare or the environment.

ECOLOGICAL RISK ASSESSMENT

A four-step process is used for assessing Site-related ecological risks for a reasonable maximum exposure scenario:

- *Problem Formulation* - a qualitative evaluation of contaminant release, migration, and fate; identification of contaminants of concern, receptors, exposure pathways, and known ecological effects of the contaminants; and selection of endpoints for further study

- *Exposure Assessment* - a quantitative evaluation of contaminant release, migration, and fate; characterization of exposure pathways and receptors; and measurement or estimation of exposure point concentrations

- *Ecological Effects Assessment* - literature reviews, field studies, and/or toxicity tests, linking contaminant concentrations to effects on ecological receptors

- *Risk Characterization* - measurement or estimation of both current and future adverse effects.

The ecological risk assessment began with evaluating the contaminants associated with the Site in conjunction with the Site-specific biological species/habitat information. The chemicals of potential concern include 9 volatile organic compounds, 16 semivolatile organic compounds, 1 pesticide, 15 inorganic analytes, and cyanide. Two potential ecological receptor species were chosen as indicator species for the Site: the red-tailed hawk (*Buteo jamaicensis*), representing a high order food web consumer, and the anole (*Anolis sp.*), a lizard representing a consumer closer to the base of the food web. Exposure to Site surface soil was the only medium considered within the ecological risk assessment; exposure of ecological receptors to Site contamination was not considered likely to occur via groundwater, surface water, or subsurface soil. Potential risks to ecological receptors were assessed by comparing estimated exposure levels (total body doses or TBDs) with toxicological benchmark values (reference toxicity values or RTVs). Exposure levels were estimated using the worst-case scenario, assuming ecological receptor exposure to maximum concentrations of Site-related surface soil chemical concentrations.

Risks to each of the selected receptors were evaluated using hazard indices which were determined for each surface soil contaminant of concern, where appropriate toxicity values were available, by dividing the estimated TBDs by the RTVs. Cumulative hazard indices were determined by summing all of the hazard indices for each target ecological receptor. Cumulative hazard indices were compared to an effects threshold of One (1) per EPA's *Framework for Ecological Risk Assessment* (EPA/630/R-92/001) to evaluate potential ecological risks to individual organisms, as follows:

- hazard index less than 1.0 = low probability of adverse effects
- hazard index greater than or equal to 1.0 = adverse effects likely to occur.

Conclusions

Anole. The potential risk from Site surface soil chemicals was assumed to arise from exposure via ingestion of soil and invertebrates. The estimated cumulative hazard index is 138, indicating the potential for adverse health risks to individual anoles as a result of exposure to Site-related chemicals in soil (primarily arsenic) if the receptor and its food sources are consistently exposed to maximum surface soil concentration. Considering the limited home range expected for the anole (less than 1 percent of the Site area), some anoles may be exposed to maximum surface soil concentrations. Examples of these areas include the O'Henry Dry Cleaners property, where the maximum concentration for arsenic and tetrachloroethylene were found, and the Curriculum Center property, where the maximum concentration for phenol was found. (see Table 10)

However, most of the anoles on and adjacent to the Site would contact much lower levels of Site-related chemicals, because the majority of Site-related chemicals have low detection frequencies and thus have not been found uniformly throughout the Site.

Since the Risk Assessment was performed, soils with the highest concentrations of PCE have been excavated from the O'Henry property in 1995. Consequently, the current potential risks to the Anole will be significantly lower than the potential risk calculated in the Ecological Risk Assessment.

Red-Tailed Hawk. The potential risk from Site surface soil chemicals was assumed to arise from exposure via ingestion of small mammals, reptiles/amphibians, invertebrates, and soil. The estimated cumulative hazard index is 4, indicating a potential for adverse health effects to the red-tailed hawk as a result of exposure to Site-related chemicals in soil if the receptor and its food sources are consistently exposed to maximum surface soil concentrations. Furthermore, the hawk appears to have a markedly reduced risk potential compared to that of the lizard. This difference is primarily attributed to the large range of the bird as compared to the area of the Site-related chemicals in surface soil. (see Table 10)

This evaluation has considered the worst-case scenario, that the receptor will be consistently using foodstuffs from the portion of the Site where maximum surface soil chemical concentrations are available. Due to the limited distribution of the majority of surface soil contaminants of concerns, the actual adverse risk to the red-tailed hawk is expected to be less than as projected by the current cumulative hazard index.

Uncertainties in the Human Health and Ecological Risk Assessments

The procedures and inputs used to assess risks in this evaluation, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- environmental chemistry sampling and analysis
- environmental parameter measurement
- fate and transport modeling
- exposure parameter estimation
- toxicological data

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the sampled media. Consequently, there is significant uncertainty as to the actual levels present. Environmental chemistry-analysis error can stem from several sources including the errors inherent in the analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the chemicals of concern, the period of time over which such exposure would occur, and in the models used to estimate the concentrations of the chemicals of concern at the point of exposure.

Uncertainties in toxicological data occur from extrapolating from animals to humans and from high to low doses of exposure; as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the Risk Assessment provides upper-bound estimates of the risks to populations near the Site, and is highly unlikely to underestimate actual risks related to the Site.

More specific information concerning public health risks, including a quantitative evaluation of the degree of risk associated with various exposure pathways, is presented in the Risk Assessment Report.

SELECTION OF SITE CLEANUP LEVELS

The cleanup levels for groundwater at the Tutu Wellfield Site are driven by MCLs and drinking water standards established by federal and territorial regulations. (see Table 11) The Tutu aquifer is classified as a potable drinking water supply, therefore the drinking water standards are the cleanup goals. It must be noted that it may not be possible to restore the aquifer to drinking water standards in those areas where DNAPLs are present.

Treatment goals for extracted groundwater may vary from aquifer remediation goals (i.e. MCLs), depending on the discharge standards that apply to the location to which treated groundwater is discharged (i.e., if treated groundwater is not used for potable supply, it may be discharged to surface water or to the sanitary sewer at appropriate discharge criteria).

There are no promulgated federal or territorial cleanup regulatory standards for soils. Furthermore, the baseline risk assessments conducted for the Site indicate that current concentrations of contaminants in Site soils present acceptable human health risks for direct exposure pathways. (The only unacceptable direct exposure risk from soils was from manganese in surface soils at the Tillett Garden and Art Center, which caused the non-carcinogenic Hazard Index for residential use to slightly exceed the target level of 1. However, the manganese concentrations in soil at this property were within the range of concentrations detected in un-impacted background soils at the Site and are therefore believed to be naturally occurring.) Therefore, site-specific cleanup guidelines for contaminants in soils were developed by EPA based on the contaminants' potential to leach into groundwater and thereby contribute to the groundwater ingestion risk.

The soil cleanup guidelines were determined by modeling contaminant transport through the vadose (unsaturated) zone using a one-dimensional mixing cell model (CDM Federal, 1995). The soil leaching calculations were based on equations derived from EPA's "Evaluation of Groundwater Extraction Remedies" (EPA/540/2-89/054, September 1989), and incorporated Site-specific information on soil characteristics (composition, porosity, organic carbon content, depth to water, etc.). The principal chemicals exceeding MCLs or driving risk in groundwater at the Tutu site are the volatile petroleum hydrocarbons (BTEX) and the chlorinated VOCs (PCE, TCE, DCE and vinyl chloride). Soil screening levels (SSLs) were therefore calculated for BTEX (using benzene as an indicator compound) and chlorinated VOCs (using PCE as an indicator compound) for four properties where soil quality is believed to be impacting groundwater quality: 1) the Curriculum Center, 2) Texaco Tutu Service Station, 3) Esso Tutu Service Station, and 4) O'Henry Dry Cleaners. SSLs for these properties are shown in Table 12. These concentrations represent a conservative estimate of residual concentrations of contaminants that could remain in soils such that the resulting groundwater concentrations would be at or below MCLs.

For properties with lesser amount of BTEX contamination, Ramsay Motors and Western Auto, separate site-specific vadose zone modeling was not performed. Instead, it was assumed that since the soil profiles (depth to bedrock, depth to water, etc) at the Esso Tutu Service Station and the Texaco Service Station are similar to those at Ramsay and Western Auto, their SSLs were appropriate screening values. The EPA's SSLs for BTEX that were calculated for Texaco and Esso were essentially the same (13 and 15 ug/kg, respectively). Therefore, Esso's SSL of 15 was applied to screen BTEX constituents at the other properties within or adjacent to the Four Winds Plaza area.

The derived SSLs are guideline values which may be adjusted by EPA as additional site-specific soils data becomes available during pre-design activities.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives are specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs) and risk-based levels established in the risk assessment.

The following remedial action objectives were established:

- Remove and/or control the sources of groundwater contamination.
- Remove contamination in groundwater. Restore the aquifer to drinking water standards, except to the extent that such full groundwater restoration proves to be technically impracticable due to the presence of DNAPLs.
- Control the migration of impacted groundwater.
- Prevent human ingestion of groundwater exhibiting excess lifetime cancer risks greater than 1 in 10,000 or a hazard index greater than 1.

- Prevent direct human contact and exposure to contaminated soils that pose excess cancer risks greater than 1 in 10,000 or a hazard index greater than 1.

- Eliminate leaching of contaminants of concern from soils into groundwater at concentrations which adversely impact groundwater quality and which might ultimately have negative ecological effects.

DESCRIPTION OF REMEDIAL ALTERNATIVES

CERCLA §121(b)(1), 42 U.S.C. §9621(b)(1), mandates that a remedial action must be protective of human health and the environment, cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants and contaminants at a site. CERCLA §121(d), 42 U.S.C. §9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA §121(d)(4), 42 U.S.C. §9621(d)(4).

This ROD evaluates in detail, five remedial alternatives (Soil Remediation Alternatives (SRA) 1, 2, 3, 4, and 5) for addressing the soil contamination and four remedial alternatives (Groundwater Remediation Alternatives (GRA) 1, 2, 3, and 4) for addressing groundwater contamination associated with the Tutu Wellfield Site. Construction times reflect only the time required to construct or implement the remedy and does not include the time required to design the remedy, negotiate with the responsible parties, procure contracts for design and construction, or conduct operation and maintenance at the Site.

In December 1995, EPA and DPNR conducted a site inspection of all properties at the Tutu Wellfield Site following the restoration of power to the area after the devastation of Hurricane Marilyn. Based on the site inspections, it was determined that no soil remedial action will be required for the Ramsay Motors property at this time. The concrete floor in the area of subsurface soil contamination had been thought to be cracked but now appears to be of sound integrity, with no visible signs of cracking, and at this time, it will not be necessary to repair this area as recommended in the FS. Institutional controls are needed as to Ramsay Motors' property, however (see the discussion of institutional controls, below).

EPA and DPNR also determined that soil remediation will not be required at the Tillett Gardens property. In September 1995, EPA and DPNR collected confirmatory soil samples from the previous area of aroclor (PCBs) contamination to verify the locations and volumes of impacted soils. No PCBs were detected in any of the samples, indicating that PCBs are no longer a concern for this property.

Soil Remedial Alternatives (SRA) For Impacted Soil:

Source Control Programs (SCPs) for the Texaco and Esso Service Stations will be implemented for SRA 2, SRA 3, SRA 4 and SRA 5. SCPs at these facilities include installation of in-situ Soil Vapor Extraction (SVE) treatment and/or bioventing of impacted soils. This action is consistent with EPA's expectation to use treatment to address principal threat wastes. The anticipated duration of each of the SCPs is 5 years. The capital cost, operation & maintenance (O & M) and total present worth costs of SRA 2, SRA 3, SRA 4 and SRA 5 include the implementation of the SCPs. The O & M cost has been estimated based on the projection that the O&M of the SCPs will continue for 5 years. (The actual O&M period may be shorter or longer than 5 years.)

<u>SRA 1: No Action/Institutional Controls</u>

Capital Cost: $15,000
O & M Present Worth: $0
Total Present Worth, 30-Yr. Cost: $15,000
Construction Time: Not applicable

The Superfund program requires that the "no-action" alternative be considered as a baseline for comparison with other alternatives. The institutional controls as recommended in SRA 1 are defined as follows for all properties within the confines of the plume which contain soil contamination that exceeds the SSLs, including: Esso Service Station, Texaco Service Station, Ramsay Motors Company, Four Winds Plaza/Western Auto, O'Henry Dry Cleaners and the Curriculum Center.

- Institutional controls in the form of Governmental controls and/or proprietary controls would be sought which place limitations on property usage (e.g., limit the properties to commercial or industrial use);

- Institutional controls in the form of Governmental controls and/or proprietary controls would be sought which prohibit excavation or soil disturbance at any of the impacted areas without prior approval, proper worker-protection precautions, and air monitoring for potential fugitive emissions;

- Institutional controls in the form of Governmental controls and/or proprietary controls would be sought which prohibit the use or transport of excavated soil or rock from impacted areas without EPA and DPNR approval;

- Institutional controls in the form of Governmental controls and/or proprietary controls would be sought which prohibit removal or disturbance of bedrock at O'Henry Dry Cleaners and the Curriculum Center where DNAPLs may be present.

SRA 2: Institutional Controls/Capping

Capital Cost: $ 311,000
O & M Present Worth: $ 396,000
Total Present Worth, 30-Yr. Cost: $ 707,000
Construction Time: 12 to 18 months

The focus of SRA 2 is to design and implement capping at all properties where impacted soil or rock is present except at the Texaco and Esso Service Stations where in-situ SVE/bioventing will be implemented as part of the SCP.

SRA 2 consists of the following actions:

- Institutional controls as described in SRA 1;
- Design and implement capping, i.e. geomembrane, pavement, concrete or soil caps, at all the properties where impacted soil or rock is present (apart from the Texaco and Esso Service Stations);
- Implement Source Control Programs (SCPs) at the Texaco and Esso Service Stations.

Capping reduces but does not eliminate leaching of contaminants of concern (COCs) to ground water. The Curriculum Center, Texaco Tutu Service Station, Esso Tutu Service Station, Four Winds Plaza/Western Auto and O'Henry Dry Cleaners have been evaluated against the SSLs and based on the property-specific circumstances, under this alternative, full or partial capping would be installed, modified, and/or maintained at each property. Caps already exist at some individual properties, while other properties would require installation of a cap or pavement, as necessary.

SRA 3: Institutional Controls/Capping/In-situ Soil Vapor Extraction (SVE)/ Excavation and Off-site Disposal

Capital Cost: $ 1,533,000
O & M Present Worth: $ 2,062,000
Total Present Worth, 30-Yr. Cost: $ 3,595,000
Construction Time: 12 to 18 months

The focus of SRA 3 is to design and implement in-situ SVE at most of the locations where contaminated soils present a threat to the groundwater. In-situ SVE is a treatment technology which consists of the installation of a network of vadose zone extraction wells or trenches in areas where soil contamination with VOCs exists. VOCs present in the unsaturated, interstitial vapor space between the soil particles are extracted under influence of a vacuum that is induced by a blower. This action upsets the equilibrium that exists between the constituents present in the interstitial vapor space and any constituents that might be present in an adsorbed phase on the soil particles or be present in the free phase. As the constituents in the vapor phase are removed by the vacuum, some of the adsorbed or free-phase constituents adjust to the shift in equilibrium by volatilizatinginto the soil pore spaces. The newly volatilized constituents are then removed under the constant influence of the vacuum that is induced by the extraction blower. For biodegradable compounds such as BTEX, an added benefit is gained from the enhanced biodegradation of these compounds by indigenous soil biota due to increased soil oxygen levels. Technologies for treating the exhaust from the extraction blower includes thermal oxidation (thermox) or catalytic oxidation (catox). During the operation of the SVE systems, an impermeable cover is installed over the impacted area to prevent short-circuiting of the systems.

The SVE systems would be operated until no VOCs are present in the extraction well air vapor system.

In particular, SRA 3 consists of the following actions:

- Institutional controls as described in SRA 1.

Texaco Tutu Service Station:

- In-situ SVE treatment of impacted soil;
- Catalytic oxidation for off-gas treatment.

Esso Tutu Service Station:

- In-situ SVE treatment and bioventing of impacted soil;
- Thermal oxidation for off-gas treatment.

Four Winds Plaza/Western Auto:

- Excavation and off-Site disposal of additional soils, if needed (to be determined after confirmatory sampling during RD).

O'Henry Dry Cleaners:

- In-situ SVE treatment of impacted soils;
- In-situ SVE treatment in the unsaturated bedrock;
- Thermal oxidation for off-gas treatment.

Curriculum Center:

- Excavation and off-Site disposal of impacted soils;
- In-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation, to remediate contaminated soils and rocks present in the unsaturated zone;
- Thermal oxidation for off-gas treatment.

While in-situ SVE is the primary remediation technique under this alternative, at properties where in-situ SVE is not feasible due to technical limitations or is cost-prohibitive (due to small volume), impacted soils would be excavated, containerized and shipped off-site for disposal.

Source removal can be achieved by excavating contaminated soil at Four Winds Plaza/Western Auto and the Curriculum Center . The excavated material would be containerized and tested for waste classification. If the soils are deemed non-hazardous, they would be disposed of locally. If they are deemed hazardous, they would be transported off-Island to a permitted hazardous waste treatment or disposal facility.

The impacted soil can be removed from properties by mechanical excavation. Standard excavating equipment, including backhoes, power shovels and clamshells can be used to excavate soil and can be decontaminated afterward. The excavated material can be containerized and loaded directly into trucks for off-site treatment or disposal.

SVE will reduce the level of contaminants in soil or bedrock at the specified properties, thus reducing the potential for leaching of contaminants to ground water and subsequent off-Site migration. The SVE systems described would be operational until no VOCs are present in the extraction well air vapor stream. Air emission controls on the SVE systems will be protective of human health and the environment by meeting emission permit standards under the Clean Air Act.

SRA 4: Institutional Controls/Capping/Ex-situ SVE/Excavation and On-site Disposal

Capital Cost: $ 1,502,000
O & M Present Worth: $ 2,038,000
Total Present Worth, 30-Yr. Cost: $ 3,540,000
Construction Time: 12 to 18 months

SRA 4 is the same as SRA 3 except that at O'Henry Dry Cleaners, there would be some excavation and ex-situ SVE of impacted soils instead of in-situ SVE, and at the Curriculum Center, the soils to be excavated would be treated via ex-situ SVE and re-deposited on Site rather than being sent off-Site for disposal.

Ex-situ SVE is the application of vapor phase extraction technologies to remove contaminants from soils that have been excavated from their original place of contamination and placed above ground. The impacted soil can be removed from properties by mechanical excavation. Standard excavating equipment, including backhoes, power shovels and clamshells can be used to excavate soil and decontaminated afterward. The excavated material can be staged for subsequent treatment, or, in the case of Four Winds Plaza/Western Auto, containerized and loaded directly into trucks for off-Site treatment or disposal.

In particular, SRA 4 consists of the following actions:

- Institutional controls as described in SRA 1.

Texaco Tutu Service Station:

- In-situ SVE treatment of impacted soil;
- Catalytic oxidation for off-gas treatment.

Esso Tutu Service Station:

- In-situ SVE treatment and bioventing of impacted soil;
- Thermal oxidation for off-gas treatment.

Four Winds Plaza/Western Auto:

- Excavation and off-Site disposal of additional soils, if needed (to be determined after confirmatory sampling during RD).

O'Henry Dry Cleaners:

- Excavation, ex-situ SVE of impacted soils and redepositing of the treated soil on-Site;

- In-situ SVE treatment in the unsaturated bedrock and soil areas not suitable for excavation, to remediate contaminated soils and rocks present above the water table;

- Thermal oxidation for off-gas treatment.

<u>Curriculum Center:</u>

- Excavation, ex-situ SVE of impacted soils and redepositing of the treated soil on-Site;

- In-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation to remediate contaminated soils and rocks present in the unsaturated zone;

- Thermal oxidation for off-gas treatment.

Ex-situ SVE will reduce the level of contaminants in soil at the specified properties, thus reducing the potential for leaching of contaminants to ground water and subsequent off-Site migration. Air emission controls on the SVE system and covering of the soil piles during treatment would be protective of human health and the environment by meeting emission permit standards. The SVE systems described would be operated until no VOCs are present in the extraction well air vapor stream. The treated soil would be disposed of on-Site.

<u>SRA 5: Institutional Controls/In-situ SVE/Excavation and Off-Site Disposal</u>

Capital Cost: $ 2,035,000
O & M Present Worth: $ 1,786,000
Total Present Worth, 30-Yr. Cost: $ 3,821,000
Construction Time: 12 to 18 months

SRA 5 is identical to SRA 3 except that at O'Henry Dry Cleaners, some of the impacted soils would be excavated and disposed of off-Site.

Specifically, SRA 5 consists of the following actions:

- Institutional controls as described in SRA 1.

Texaco Tutu Service Station:

- In-situ SVE treatment of impacted soil;
- Catalytic oxidation for off-gas treatment.

Esso Tutu Service Station:

- In-situ SVE treatment and bioventing of impacted soil;
- Thermal oxidation for off-gas treatment.

Four Winds Plaza/Western Auto:

- Excavation and off-Site disposal of additional soils, if needed (to be determined after confirmatory sampling during RD).

O'Henry Dry Cleaners:

- Excavation and off-Site disposal of impacted soils;
- In-situ SVE treatment in the unsaturated bedrock and soil areas not suitable for excavation, to remediate contaminated soils and rocks present above the water table;
- Thermal oxidation for off-gas treatment.

Curriculum Center:

- Excavation and off-Site disposal of impacted soils;
- In-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation, to remediate contaminated soils and rocks present in the unsaturated zone;
- Thermal oxidation for off-gas treatment.

Soil at individual properties where contamination is above the SSLs identified for the Tutu Wellfield Site would be excavated and containerized except at the Texaco and Esso Service Stations. The excavated contaminated soil would be sampled to determine if it is hazardous waste. If the soils are deemed non-hazardous, they would disposed of locally. If they are deemed hazardous, they would be transported off-Island to a permitted hazardous waste treatment or disposal facility. Clean fill material would be brought in to restore each of the areas to grade. Topsoil and seed or paving would be installed to finish the restoration.

The impacted soil can be removed from properties by mechanical excavation. Standard excavating equipment, including backhoes, power shovels and clamshells can be used to excavate soil and decontaminated afterward. The excavated material can be containerized and loaded directly into trucks for off-site treatment or disposal.

Groundwater Remedial Alternatives (GRA) for Impacted Groundwater:

Source Controls Programs (SCPs) for Texaco and Esso Service Stations will be implemented as an early remedial action for GRA 2, GRA 3 and GRA 4. The early remedial action will consist of installation of extraction wells and air strippers to contain and treat the plumes of impacted groundwater at these facilities. The capital cost, operation & maintenance (O & M) and total present worth costs of GRA 2, GRA 3 and GRA 4 include the implementation of the SCPs. The anticipated duration of each SCP is 5 years, though the actual duration may prove to be shorter or longer than that estimate.

GRA 1: No Action/Institutional Controls/Monitoring

Capital Cost: $ 15,000
O & M Present Worth: $ 1,377,000
Total Present Worth, 30-Yr. Cost: $ 1,392,000
Construction Time: 12 months

Under this alternative, institutional controls in the form of governmental and/or proprietary controls would be sought to prevent the installation of new supply wells in the affected area. Water would continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rain water to cisterns and trucking water by tanker trucks).

More specially, GRA 1 consists of the following actions:

- Institutional controls to prohibit unauthorized use of groundwater or installation of new wells. Authorization must be obtained from DPNR and EPA before use of existing wells or installation of any new wells within the confines of the plume area.

- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program includes sampling approximately 15 wells at or near the plume boundary for VOCs and BNAs, and would last throughout the remedial action and O&M (estimated, for costing purposes, to be approximately 30 years).

GRA 2: Institutional Controls/Source Containment/POET Systems/Treatment/Discharge

Capital Cost: $ 2,366,000
O & M Present Worth: $ 6,223,000
Total Present Worth, 30-Yr. Cost: $ 8,589,000
Construction Time: 12 to 18 months

GRA 2 consists of a methodology for hydraulic containment of the potential groundwater contamination source areas (O'Henry Dry Cleaners and the Curriculum Center) that exhibit the highest groundwater VOC concentrations, and incorporates treatment of pumped groundwater and either discharge of treated water to surface water or discharge for distribution for potable purposes. In other areas of the aquifer, natural attenuation would be relied upon.

The total flow capacity of the treatment facility would be 55 gpm. Property acquisition might be required for such treatment facility.

GRA 2 consists of the following elements:

- Efforts would be made to have existing domestic and commercial wells within the confines of the groundwater plume decommissioned if these wells are determined to interfere with the operation of the groundwater pump and treat system that will be installed as part of this remedial action. During the remedial design it will be determined which wells would interfere with this remedial action and which wells would continue to operate as they may enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.

- Institutional controls to prohibit unauthorized use of groundwater or installation of new wells. Authorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.

- Implement SCPs at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facilities.

- Install two groundwater recovery wells (RW-4 and RW-5) for hydraulic control of chlorinated VOC contaminant sources. The source containment would provide hydraulic barriers around source areas, allowing the reduction of contaminants in other parts of the aquifer and potentially reducing the time needed to reach

MCLs through treatment in large portions of the Tutu Wellfield Site. (See Figure 5)

- Install point of entry treatment systems (POETS) at the Four Winds Plaza, and the Steele, Smith, Laplace and Matthias residences.

- Construct a central groundwater treatment facility with total flow capacity of 55 gallons per minute (gpm). Water would be treated to surface water criteria for discharge via the storm sewer near the O'Henry Dry Cleaners to Turpentine Run or would be treated to MCLs for distribution for potable purposes.

- Natural attenuation of low concentration contaminants at the plume edges.

- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program includes sampling approximately 15 wells at or near the plume boundary for VOCs and BNAs, and would last througout the remedial action and O&M (estimated, for costing purposes, to be approximately 30 years).

<u>GRA 3: Institutional Controls/Plume Containment/Treatment/Discharge</u>

Capital Cost: $ 2,537,000
O & M Present Worth: $ 4,929,000
Total Present Worth, 30-Yr. Cost: $ 7,466,000
Construction Time: 12 to 18 months

GRA 3 consists of a methodology for hydraulic containment of the delineated plumes and incorporates treatment of pumped groundwater and either discharge of treated pumped groundwater to surface water or discharge for potable purposes.

This proposed containment program would include the installation of at least three recovery wells (RW-1, RW-2 and RW-3). These wells would be strategically placed to hydraulically contain plume migration. Selected residential and commercial groundwater use in some areas would counteract the hydraulic containment program and reduce the program's effectiveness in containing the impacted groundwater. Thus, this alternative would include the same institutional controls (including some well decommissioning) as described in GRA 2.

The total flow capacity of the treatment facility would be 55 gpm. Property acquisition might be required for such treatment facility; the facility would be located in the vicinity of the southern plume containment wells. This location would be at a lower elevation when compared to the rest of the Tutu Wellfield Site, thus reducing pumping requirements.

GRA 3 consists of the following elements:

- Efforts would be made to have existing domestic and commercial wells within the confines of the groundwater plume decommissioned if these wells are determined to interfere with the operation of the groundwater pump and treat system that will be installed as part of this remedial action. During the remedial design it will be determined which wells would interfere with this remedial action and which wells would continue to operate as they may enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.

- Institutional controls to prohibit unauthorized use of groundwater or installation of new wells. Authorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.

- Implement SCPs at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facilities.

- Install groundwater recovery wells for hydraulic control of plume migration. The proposed containment program would include the installation of three recovery wells (RW-1, RW-2, and RW-3) strategically placed in an effort to hydraulically contain plume migration. (See Figure 5)

- Construct a central groundwater treatment facility with total flow capacity of 55 gallons per minute (gpm). Water would be treated to surface water criteria for discharge via the storm sewer near the O'Henry Dry Cleaners to Turpentine Run or would be treated to MCLs for distribution for potable purposes. If a decision is made to treat the water to surface water criteria (not to MCLs), then water would continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rain water to cisterns and trucking water by tanker truck).

- Natural attenuation of low concentration contaminants at the plume edges.

- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program includes the sampling approximately 15 wells at or near the plume boundary for VOCs and BNAs, and would last for the duration of the remedial action and O&M (estimated, for costing purposes, to be approximately 30 years).

GRA 4: Institutional Controls/Source and Plume Containment/Treatment/Discharge

Capital Cost: $ 3,175,000
O & M Present Worth: $ 5,856,000
Total Present Worth, 30-Yr. Cost: $ 9,031,000
Construction Time: 12 to 18 months

GRA 4 is identical to GRA 3, with the addition of the installation of two groundwater recovery wells for hydraulic control of two of the areas identified as potential source areas (O'Henry Cleaner and Curriculum Center). GRA 4 proposes the containment of plume migration as well as hydraulic source containment in areas that are suspected of being sources of impacts to ground water. (See Figure 5)

The source containment would provide hydraulic barriers around source areas, thus reducing COCs in other parts of the aquifer, and would likely reduce the time needed to reach MCLs in large portions of the Tutu Wellfield Site. The plume containment wells would prevent the continued migration of Site contaminants.

The total flow capacity of the treatment facility would be 100 gpm. Property acquisition might be required for such treatment facility; the facility would be located in the vicinity of the southern plume containment wells. This location would be at a lower elevation when compared to the rest of the Tutu Wellfield Site, thus reducing pumping requirements.

GRA 4 involves the following actions:

- Efforts would be made to have existing domestic and commercial wells within the confines of the groundwater plume decommissioned if these wells are determined to interfere with the operation of the groundwater pump and treat system that will be installed as part of this remedial action. During the remedial design it will be determined which wells would interfere with this remedial action and which wells would continue to operate as they may enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.

- Institutional controls to prohibit unauthorized use of groundwater or installation of new wells. Authorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.

- Implement SCPs at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facility.

- Install groundwater recovery wells for hydraulic control of plume migration. The proposed containment program would include the installation of three recovery wells (RW-1, RW-2, and RW-3) strategically placed in an effort to hydraulically contain plume migration. (See Figure 5)

- Install two groundwater recovery wells (RW-4 and RW-5) for hydraulic control of chlorinated VOC contaminant sources. The source containment would provide hydraulic barriers around source areas, allowing the reduction of contaminants in other parts of the aquifer and potentially reducing the time needed to reach MCLs in large portions of the Tutu Wellfield Site. (See Figure 5)

- Construct a central groundwater treatment facility with total flow capacity of 100 gallons per minute (gpm). Water would be treated to surface water criteria for discharge via the storm sewer near the O'Henry Dry Cleaners to Turpentine Run or would be treated to MCLs for distribution for potable purposes. If a decision is made to treat the water to surface water criteria (not to MCLs), then water would continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rain water to cisterns and trucking water by tanker truck).

- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program includes the sampling approximately 15 wells at or near the plume boundary for VOCs and BNAs, and would last for the duration of the remedial action and O&M (estimated, for costing purposes, to be approximately 30 years).

- Natural attenuation of low concentration contaminants at the plume edges.

Various potable use options for treated water are as follow:

  - connect to the existing Water and Power Authority water main;

  - truck the treated water to the impacted residences within the plume area;

  - install a water distribution system from the central treatment facility to the impacted residences within the plume area.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy, EPA considered the factors set out in CERCLA §121, 42 U.S.C. §9621, by conducting a detailed analysis of the viable remedial alternatives pursuant to the NCP, 40 CFR §300.430(e)(9) and OSWER Directive 9355.3-01. The detailed analysis consisted of an assessment of the individual alternatives against each of nine evaluation criteria and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

The following "threshold" criteria must be satisfied by any alternative in order to be eligible for selection:

1. *Overall protection of human health and the environment* addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. *Compliance with ARARs* addresses whether or not a remedy would meet all of the applicable (legally enforceable), or relevant and appropriate (requirements that pertain to situations sufficiently similar to those encountered at a Superfund site such that their use is well suited to the site) requirements of federal and state environmental statutes and requirements or provide grounds for invoking a waiver.

The following "primary balancing" criteria are used to make comparisons and to identify the major trade-offs between alternatives:

3. *Long-term effectiveness and permanence* refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. *Reduction of toxicity, mobility, or volume via treatment* refers to a remedial technology's expected ability to reduce the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants at the site.

5. *Short-term effectiveness* addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation periods until cleanup goals are achieved.

6. *Implementability* refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed.

7. *Cost* includes estimated capital and operation and maintenance costs, and the present-worth costs.

The following "modifying" criteria are considered fully after the formal public comment period on the Proposed Plan is complete:

8. *Territorial acceptance* indicates whether, based on its review of the RI/FS and the Proposed Plan, the Territory supports, opposes, and/or has identified any reservations with the preferred alternative.

9. *Community acceptance* refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports. Factors of community acceptance to be discussed include support, reservation, and opposition by the community.

A comparative analysis of the remedial alternatives based upon the evaluation criteria noted above follows:

- Overall Protection of Human Health and the Environment

SRA 1 (No Action/Institutional Controls) does not meet the requirements of this criterion due to the current and potential future exposures to unacceptable levels of contamination. In addition, it is unclear whether adequate institutional controls could be obtained and would remain in place over time. SRA 3, SRA 4 and SRA 5 provide equal protection of human health and the environment because they mitigate exposure to contaminants and reduce their migration to the environment through capping, excavation or soil treatment by vapor extraction.

GRA 1 does not meet this criterion. GRA 2 does not meet this criterion in part because POET systems are not considered an adequate long-term solution for potential impact on human health. GRA 3 and GRA 4 will meet this criterion as long as recovery well capture zones are effective and institutional controls are effectively enforced. GRA 4 will provide the maximum protection of human health and the environment because it provides the maximum capture of impacted groundwater by implementing both plume and source containment.

- Compliance with ARARs

The major ARARs for soil remediation are the RCRA Land Disposal Restrictions (LDRs). The major "To-be-Considered" (TBCs) criteria are the SSLs which are the preliminary cleanup goals. The SSLs are guidance values to identify soil areas that may require remediation based on the potential for leaching of contaminants into groundwater. The EPA's SSLs may be revised after additional soil organic carbon, soil and groundwater contaminant concentration data and other pertinent hydrogeologic data are collected during the pre-design phase. SRA 1 and SRA 2 will not comply with TBCs because no soil would be removed and soil contaminant levels would not be reduced below SSLs and thus could continue to act as a source of contamination to the groundwater. SRA 3, SRA 4 and SRA 5 can comply with the SSLs for all properties that undergo excavation or treatment. Excavation and disposal proposed in SRA 3, SRA 4 and SRA 5 can comply with LDRs for off-Site disposal.

Major ARARs for groundwater remediation include the Federal Safe Drinking Water Act and its implementing regulations, and the Virgin Islands Drinking Water Standards (Title 19, Chapter 51 of the Virgin Islands Code), which establish Maximum Contaminant Levels (MCLs) for drinking water. In addition, the Virgin Islands Water Pollution Control Act requires Territorial Pollution Discharge Elimination System (TPDES) permits which establish discharge limits to surface water. The Federal Executive Order 11990 for the Protection of Wetlands also requires any remedial action to minimize harm to or within wetlands.

GRA 1 (No Action/Institutional Controls) does not comply with ARARs because without active remediation, it is uncertain whether the aquifer will ever attain MCLs. All other treatment schemes (GRA 2, GRA 3, and GRA 4) have the ability to meet ARARs over time. However, GRA 4 would best meet this criterion because it has the ability to restore the aquifer the quickest.

Full groundwater restoration at the Curriculum Center and O'Henry Dry Cleaners properties might prove to be technically impracticable due to the suspected presence of DNAPLs. Therefore, a waiver of MCLs ultimately may be required for the Curriculum Center and O'Henry Dry Cleaners properties groundwater. EPA's memorandum <u>Guidance for Evaluating the Technical Impracticability of Groundwater Remediation (OSWER Directive 9233334.2-25, October 1993)</u> recognizes that the presence of DNAPLs may make groundwater restoration technically impracticable.

- <u>Long-Term Effectiveness and Permanence</u>

SRA 1 does not meet this criterion. SRA 2 is effective at minimizing the transport of impacted soil or leaching of contaminants, but does not totally eliminate potential future exposure. SRA 3/SRA 4 and SRA 5 address this criterion by either removing contaminated soils from the Site or reducing the levels of contamination in soils. A combination of SRA 3/SRA 4 would be the most favorable remedy in complying with this criterion. The long-term effectiveness and permanence of SRA 3/SRA 4 is very high in that the contaminated soils would be treated and the contaminated areas restored.

GRA 2 is not effective as a long-term or permanent remedy. The potential for off-Site groundwater transport of contaminants may still exist, depending on the ability to utilize private wells and to coordinate their pumpage to hydraulically contain impacted groundwater. GRA 3 is not considered favorable for this criterion because effectiveness of the plume capture would be contingent upon RW-1, RW-2 and RW-3. Since there are no source containment wells in GRA 3, other than the SCPs, sources may continue to be active. GRA 4 would be the most effective GRA for this criterion because it provides both plume and source containment, and the greatest potential for remediation of the aquifer.

- Reduction in Toxicity, Mobility, or Volume Through Treatment

SRA 1 and SRA 2 do not provide treatment or reduction in contaminant volume and therefore do not comply with this criterion, although capping or impermeable cover (for all alternatives) does reduce contaminant transport to the groundwater. SRA 3/SRA 4 reduce toxicity, mobility and volume of impacted soil by treatment. SRA 5 would also reduce the toxicity, mobility and volume of impacted soils by treatment, though some of the impacted soils at the O'Henry Dry Cleaners facility would be excavated and shipped off-Site for disposal, rather than being treated through in-situ or ex-situ SVE. SRA 4 has the most potential for reducing soil contaminants because some of the impacted soil would be treated in an engineered environment rather than *in-situ*.

GRA 2 would be moderately effective in the reduction of toxicity, mobility and volume because source control would result in contaminant removal from groundwater, and intermittent pumping of residential wells equipped with POETs would also result in some reduction in the volume of COCs in groundwater. The toxicity, mobility and volume of impacted groundwater in GRA 3 would be reduced through containment and pumping; however, the potential presence of DNAPLs in the bedrock aquifer at the Site could act as a continual source of groundwater contamination throughout the life of the remedial action. GRA 4 would extract and treat the most impacted ground water, thus maximizing the reduction in toxicity, mobility, and volume. The effects of DNAPLs that may be present in the bedrock aquifer would be reduced with source control, decreasing the time needed to reduce contaminant concentrations within most of the aquifer.

- Short-Term Effectiveness

SRA 2 (Institutional Controls/Capping) would be most effective in the short-term because it would minimize the fugitive emissions caused by installation of a remedy and reduce the off-Site impacts. Moderate short-term impacts would occurred during the implementation of SRA 3/SRA 4. The impacts would be caused by fugitive emissions and the potential erosion associated with installing caps, SVE wells, and/or excavation. However, dust control and emission monitoring and control measures would be implemented during construction to minimize short-term impacts.

GRA 2 would minimize the amount of construction or disturbance that is required for installation, and therefore, it would be the most effective GRA at addressing this criterion. The construction related to GRA 3 and GRA 4 is greater than that of GRA 2, thus creating more potential for impacts to workers and area residents. However, any impacts could be easily controlled.

- Implementability

All of the SRAs evaluated are implementable.

Difficulties might be encountered in seeking to implement some or all of the institutional controls under the various soil and groundwater remedial alternatives. For example, the existing wells are owned by individual property owners, which may create a need for a significant amount of coordination. It may be difficult to ensure that the wells on Site will not be pumped and that the safe yield for the aquifer will not be exceeded. GRA 2 is the least implementable of all the GRAs because operation issues could be significant due to maintenance related to the treatment facility and the operation of individual property owner POET systems. GRA 4 would not be favorable under this criterion because it has the most significant administrative requirements. GRA 4 places the greatest withdrawal demand on the Tutu aquifer and may create upconing of mineralized water in some areas of the aquifer. Therefore, pre-design studies must carefully optimize required pumping rates. GRA 3 would be the most implementable because this GRA is the least obtrusive, minimizing the amount of impact to the area. The treatment system design for GRA 3 would be simple to operate, as it would be at a minimum flow rate and would require the least amount of equipment and materials to construct.

- Cost

The cost estimates associated with the alternatives are presented above. SRA 3 and SRA 4, respectively, are the lowest cost soil alternatives that include some sort of treatment of impacted soils (total present worth of approximately $ 3.6 million). SRA 5 has a slightly higher total present worth of $ 3.8 million and SRA 2 has the lowest total present worth of $ 707,000.

GRA 3 has the lowest cost with a total present worth of $ 7.5 million, followed by GRA 2 with a total present worth of $ 8.6 million. GRA 4 has the highest cost with a total present worth of $ 9.0 million.

- Territorial Acceptance

The Virgin Islands Department of Planning and Natural Resources concurs with the selected remedy.

- Community Acceptance

Community acceptance of the preferred remedy has been assessed in the Responsiveness Summary portion of this ROD following the review of all public comments received on the RI/FS report and the Proposed Plan. All comments submitted during the public comment period were evaluated and are addressed in the attached Responsiveness Summary (Appendix V).

SELECTED REMEDY

EPA and DPNR have determined after reviewing the alternatives and public comments, that Alternatives SRA 3/SRA 4 and GRA 4 are the appropriate remedies for the Site, because they best satisfy the requirements of CERCLA §121, 42 U.S.C. §9621, and the NCP's nine evaluation criteria for remedial alternatives, 40 CFR §300.430(e)(9).

The major components of the selected remedy are as follows:

SOIL REMEDIATION ALTERNATIVE (SRA 3/4)

- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which place limitations on property usage (e.g., for commercial or industrial use only);
- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which ensure that excavation or soil disturbance at any of the impacted areas will not occur in the future without full permit approval, proper worker-protection precautions, and air monitoring for potential fugitive emissions;
- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which prohibit the excavation, transportation and usage of soil or rock from impacted areas without EPA and DPNR approval;
- Institutional controls in the form of Governmental controls and/or proprietary controls will be sought which prevent permanently the removal or disturbance of bedrock at O'Henry Dry Cleaners and the Curriculum Center where DNAPLs may be present in the subsurface.

The following remedial activities will take place at the affected properties:

<u>Texaco Tutu Service Station:</u>

- In-situ Soil Vapor Extraction (SVE) treatment of ıpacted soil;
- Catalytic oxidation for off-gas treatment.

<u>Esso Tutu Service Station:</u>

- In-situ SVE treatment and bioventing of impacted soil;

- Thermal oxidation for off-gas treatment.

Four Winds Plaza/Western Auto:

- Excavation and off-Site disposal of additional soils, if needed (to be determined after confirmatory sampling during remedial design).

O'Henry Dry Cleaners:

- In-situ SVE treatment of impacted soils or, if such in-situ SVE proves to be ineffective, excavation and ex-situ SVE treatment of impacted soils followed by the redepositing of the treated soil on-Site;

- In-situ SVE treatment in the unsaturated bedrock;

- Thermal oxidation for off-gas treatment.

Curriculum Center:

- Excavation of impacted soils, followed by either off-Site disposal, or ex-situ SVE and redepositing of the treated soil on-Site;

- In-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation, to remediate contaminated soils and rocks present in the unsaturated zone;

- Thermal oxidation for off-gas treatment.

The potential effectiveness of in-situ SVE will be determined during the pre-design phase. Additional source delineation is required prior to installation of the in-situ SVE treatment systems to insure the effectiveness of the remediation.

Buried 4-inch diameter PVC piping may be a potential source of contamination at the Four Winds Plaza, near the former Western Auto underground storage tank area. Additional investigation during the pre-design phase will be conducted to determine the need for remedial work in the areas of the Four Winds Plaza. Western Auto removed its underground storage tank and paved the area with a concrete cap. Confirmatory sampling of the tank grave area will be completed to confirm that no residual contaminated soil above the SSLs is left in-place. If such soil is present, it will be excavated and disposed of off-Site.

GROUNDWATER REMEDIATION ALTERNATIVE (GRA 4)

- Efforts will be made to have existing domestic and commercial wells within the confines of the groundwater plume decommissioned if these wells are determined to interfere with the operation of the groundwater pump and treat system that will be installed as part of this remedial action. During the remedial design it will be determined which wells would interfere with this remedial action and which wells would continue to operate as they may enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.

- Institutional controls (in the form of Governmental control and/or proprietary controls) will be sought to prohibit unauthorized use of groundwater or the installation of new wells. Autnorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.

- Implement Source Control Programs (consisting of installation and operation of extraction wells and air strippers) at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facilities.

- Install groundwater recovery wells for hydraulic control of plume migration. The proposed containment program will include the installation of three recovery wells (RW-1, RW-2, and RW-3) strategically placed in an effort to hydraulically contain plume migration. (See Figure 5)

- Install two groundwater recovery wells (RW-4 and RW-5) for hydraulic control of chlorinated VOC contaminant sources. The source containment will provide hydraulic barriers around source areas, allowing the reduction of contaminants in other parts of the aquifer and potentially reducing the time needed to reach Maximum Contaminant Levels (MCLs). (See Figure 5)

- Construct a central groundwater treatment facility with a total flow capacity of 100 gpm. Water will be treated to surface water criteria for discharge to the storm sewer near the O'Henry Dry Cleaners facility leading to Turpentine Run or treated to MCLs for distribution for potable purposes. EPA, in consultation with the Virgin Islands Government, will choose one of these two options during the remedial design phase. If a decision is made to treat the water to surface water criteria (not to MCLs), then water will continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rain water to cisterns and trucking water by tanker truck).

- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program will include the sampling of approximately 15 wells at or near the plume boundary for VOCs and base, neutral and acids, and would last for the duration of the remedial action and O&M (estimated, for costing purposes, to be about 30 years).

- Natural attenuation of low concentration contaminants at the plume edges and downgradient of RW-2 and RW-3.

Various potable use options with respect to the treated groundwater are as follows:

- connect to the existing Water and Power Authority water main;

- truck the treated water to the impacted residents within the plume area;

- install a water distribution system from the central treatment facility to the impacted residents within the plume area.

EPA, in consultation with the Virgin Islands Government, will choose one of these options during the remedial design phase. Additional field work will be required during the pre-design stage prior to implementation of this remedy. Groundwater extraction system design will be based on field and aquifer testing and groundwater modelling. A wetlands assessment may be required if the groundwater modelling shows an adverse effect from discharges of treated water to the wetlands.

STATUTORY DETERMINATIONS

As previously noted, CERCLA §121(b)(1), 42 U.S.C. §9621(b)(1), mandates that a remedial action must be protective of human health and the environment, cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) and the NCP (40 CFR Section 300.430(a)(1)(iii)), also establish a preference for remedial actions which employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants, or contaminants at a site. CERCLA §121(d), 42 U.S.C. §9621(d), further specifies that a remedial action must attain a degree of cleanup that satisfies ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA §121(d)(4), 42 U.S.C. §9621(d)(4).

For the reasons discussed below, EPA has determined that the selected remedy meets the requirements of CERCLA §121, 42 U.S.C. §9621:

Protection of Human Health and the Environment

SRA 3/SRA 4 afford the protection of human health and the environment by treatment of impacted soils to reduce their volumes, mobilities and toxicities. SVE is a presumptive remedy technology that has proven effective in treating VOCs in soils. SVE will provide long-term effectiveness and permanence and will maintain reliable protection of human health and the environment over time.

GRA 4 provides the maximum protection of human health and the environment because it provides the maximum capture of impacted groundwater by implementing both plume and source containment. This alternative extracts and treats the most impacted groundwater, thus maximizing the reduction of the toxicity, mobility and volume of hazardous substances in the groundwater. Implementing plume and source containment would provide the greatest potential for remediation of the aquifer. Implementing source containment should expedite the remediation of other portions of the aquifer and make these portions of the aquifer useable sometime in the future. It is possible that MCLs may not be achieved at locations where DNAPLs are present.

Compliance with ARARs

The selected soil and groundwater remedy will be in compliance with all ARARs, subject to the discussion of DNAPLs, below.

The major ARARs for soil remediation are the RCRA Land Disposal Restrictions (LDRs). The major "To-be-Considered" (TBCs) criteria are the SSLs which are the preliminary cleanup goals. SRA 3 and SRA 4 will comply with the SSLs for all properties that undergo excavation or treatment. Excavation and disposal proposed in SRA 3 and SRA 4 will comply with LDRs for off-Site disposal. Appropriate air pollution control equipment will be selected during the remedial design, subject to Federal and Territorial approval. Emissions controls would be installed as required to comply with Federal and Territorial air regulations.

ARARs for groundwater remediation include the Federal Safe Drinking Water Act and its implementing regulations and the Virgin Islands Drinking Water Standards (Title 19, Chapter 51 of the Virgin Islands Code), which establish Maximum Contaminant Levels (MCLs) for drinking water. In addition, the Virgin Islands Water Pollution Control Act requires Territorial Pollutant Discharge Elimination System (TPDES) permits which establish discharge limits to surface water. The Federal Executive Order 11990 for the Protection of Wetlands also requires any remedial action to minimize harm to or within wetlands.

EPA recognizes that the restoration of certain portions of the Tutu aquifer to MCLs may be technically impracticable, due to the high probability that DNAPLs are present in the unsaturated and/or saturated soils and fractured bedrock at the Curriculum Center and O'Henry Dry Cleaners properties. If DNAPLs are present in either of these areas, there are technical limitations, from an engineering perspective, which may make it impracticable to find and remove all the DNAPLs from these properties. This will be especially true if DNAPLs are present in the complex fractured bedrock, either above or below the water table. Because DNAPL contributes to dissolved phase groundwater contamination, restoration of groundwater in the vicinity of the Curriculum Center and O'Henry Dry Cleaners may be technically impracticable.

However, insufficient Site characterization data are available at this time to support a Technical Impracticability (TI) evaluation. The future determination of technical impracticability will be made by EPA based on site-specific characterization data obtained during remedial design and by remedy performance data collected from soil vapor extraction wells and groundwater extraction wells. If further supporting evidence for the existence of a DNAPL constraint is found, it should still be feasible and practicable to at least: 1) limit further migration of contaminated groundwater using a containment system; and 2) restore that portion of the aqueous plume outside of the containment area. In such a case, the TI waiver will be spacially restricted to a limited TI zone, which lies within a groundwater containment area. Outside of the TI zone, ARARs would still apply.

All reasonable efforts will be made to identify the location of DNAPLs source areas through historical information searches and site characterization efforts. Even if a TI waiver is ultimately invoked, contamination sources must be identified and removed or treated to the extent practicable.

Cost-Effectiveness

The selected soil remedy is cost-effective. It has been demonstrated to provide overall effectiveness proportional to its cost. This technology has proven effective in reducing VOC contaminant concentrations at their source, thereby reducing the time needed for the pump and treat groundwater remedy. Thus, the selected groundwater alternative is cost-effective. The present worth of the selected soil remedy is $3,595,000.

Although the selected groundwater remedy is more expensive than most of the alternatives analyzed, these alternatives did not include plume and source containment and treatment, which are critical components in meeting the remedial action objectives and satisfying the statutory criteria. Thus, the selected groundwater alternative is cost-effective. The present worth of the selected groundwater remedy is $ 9,031,000.

The Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The selected remedy provides the best balance of trade-offs among the alternatives with respect to the evaluation criteria

The selected soil remedy will reduce the toxicity, volume and mobility of the impacted soil from source areas by providing treatment. In addition, the selected groundwater remedy will control the migration of contaminated groundwater and provides treatment of this groundwater.

Preference for Treatment as a Principal Element

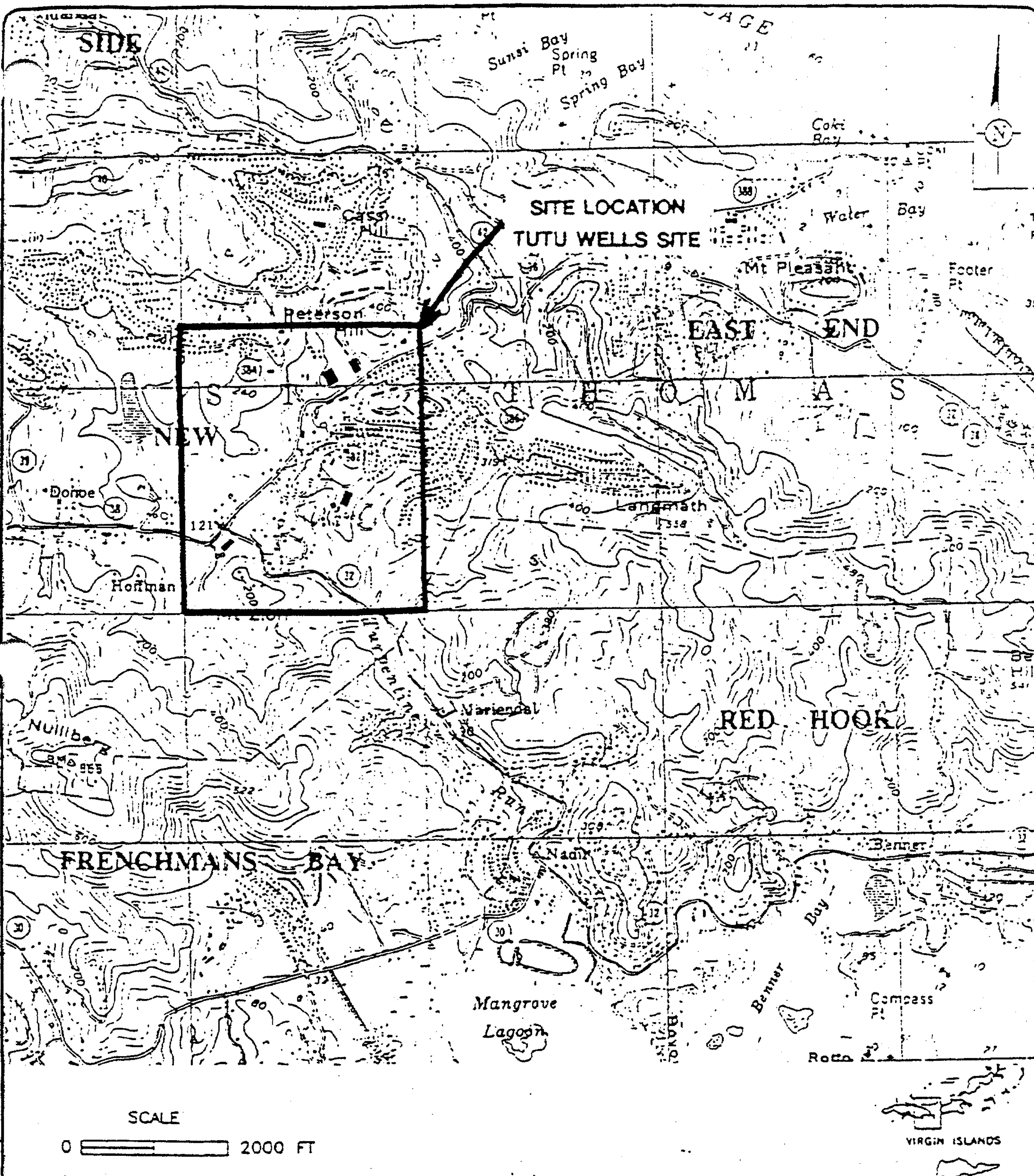
In keeping with the statutory preference for treatment as a principal element of the remedy, the remedy provides for the treatment of impacted soil, and contaminated groundwater at the Site. By treating the impacted soil and the contaminated groundwater at and near the source areas, all exposure pathways will be eliminated.

DOCUMENTATION OF SIGNIFICANT CHANGES

The present worth O&M costs were revised using a 5% discount rate versus the 3% rate which was used in the Proposed Plan. Therefore, the total present worth costs for all the soil remedial alternatives (except SRA 1- Institutional controls) and groundwater remedial alternatives are revised.

APPENDIX I

FIGURES



SOURCE: USGS-EASTERN ST. THOMAS, VIRGIN ISLANDS, 1954 (PHOTOREVISED - 1982)

GERAGHTY & MILLER, INC.
Environmental Services
A Heidemij Company

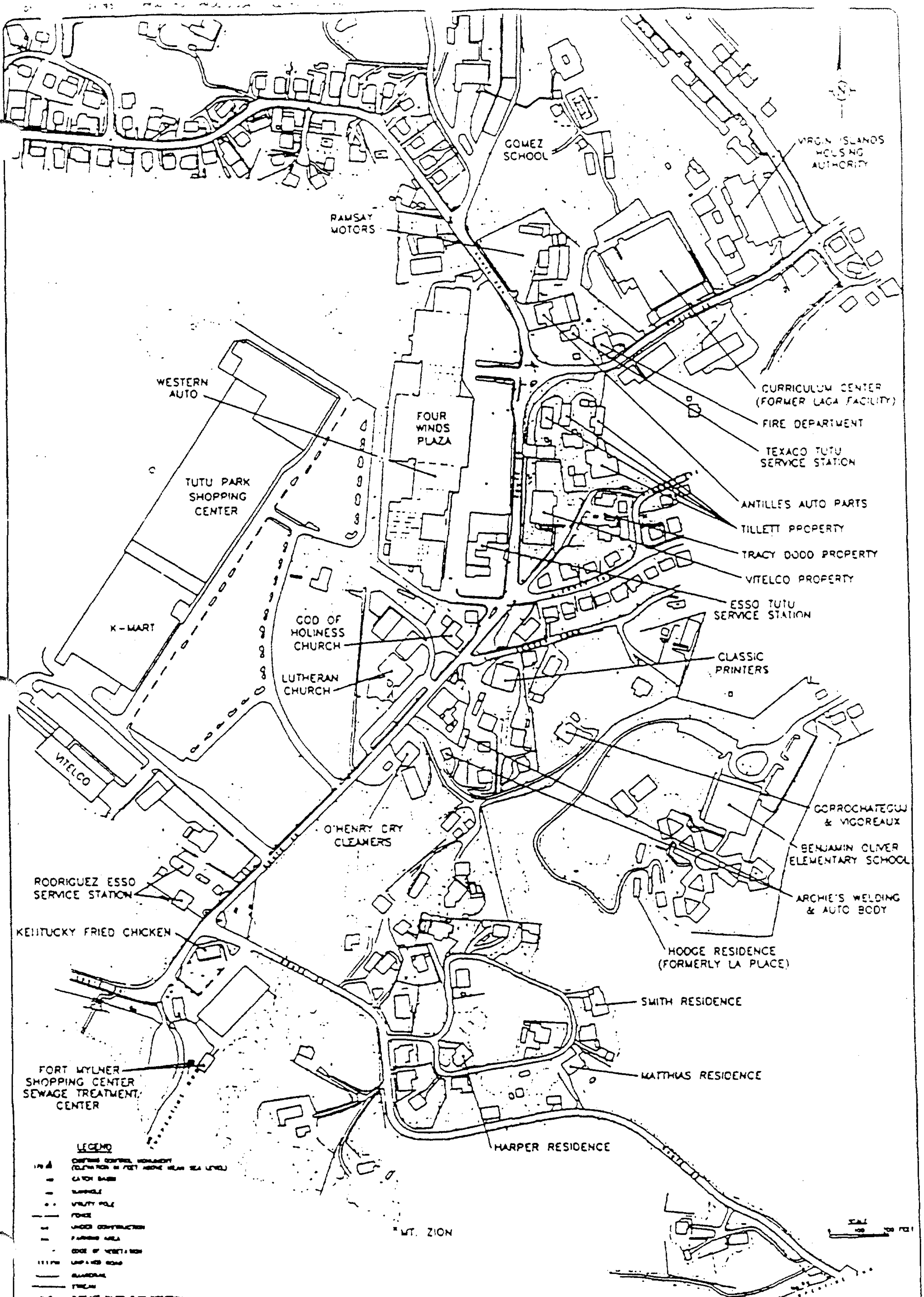
SITE LOCATION

TUTU WELLS SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE
1

DWG: | 2-24-95 | PRJCT NO.: PRO013.036 | HARD FILE: TU-421 | DRAWING: 1 | CHECKED: D. STERN | APPROVED: T. DWAN

TUT 008 0793



GERAGHTY & MILLER, INC.
Environmental Services

PROPERTY LOCATIONS

TUTU WELLS SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 2

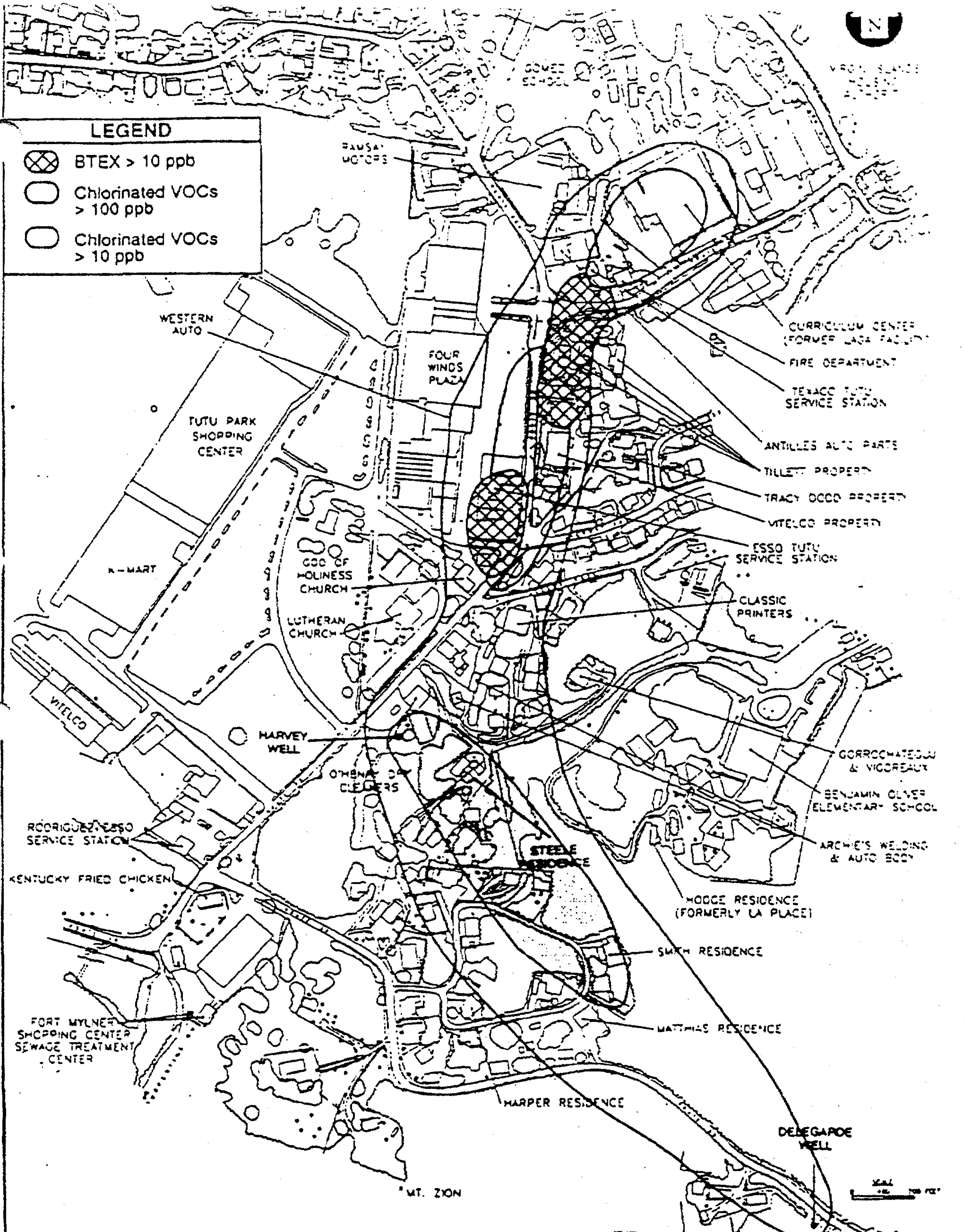
TUT 008 0794

Source: Geraghty & Miller, Inc. Phase II RI, 1994.

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

TUTU WELLS SITE
ST. THOMAS, U.S. VIRGIN ISLANDS
Figure

TUT 008 0795



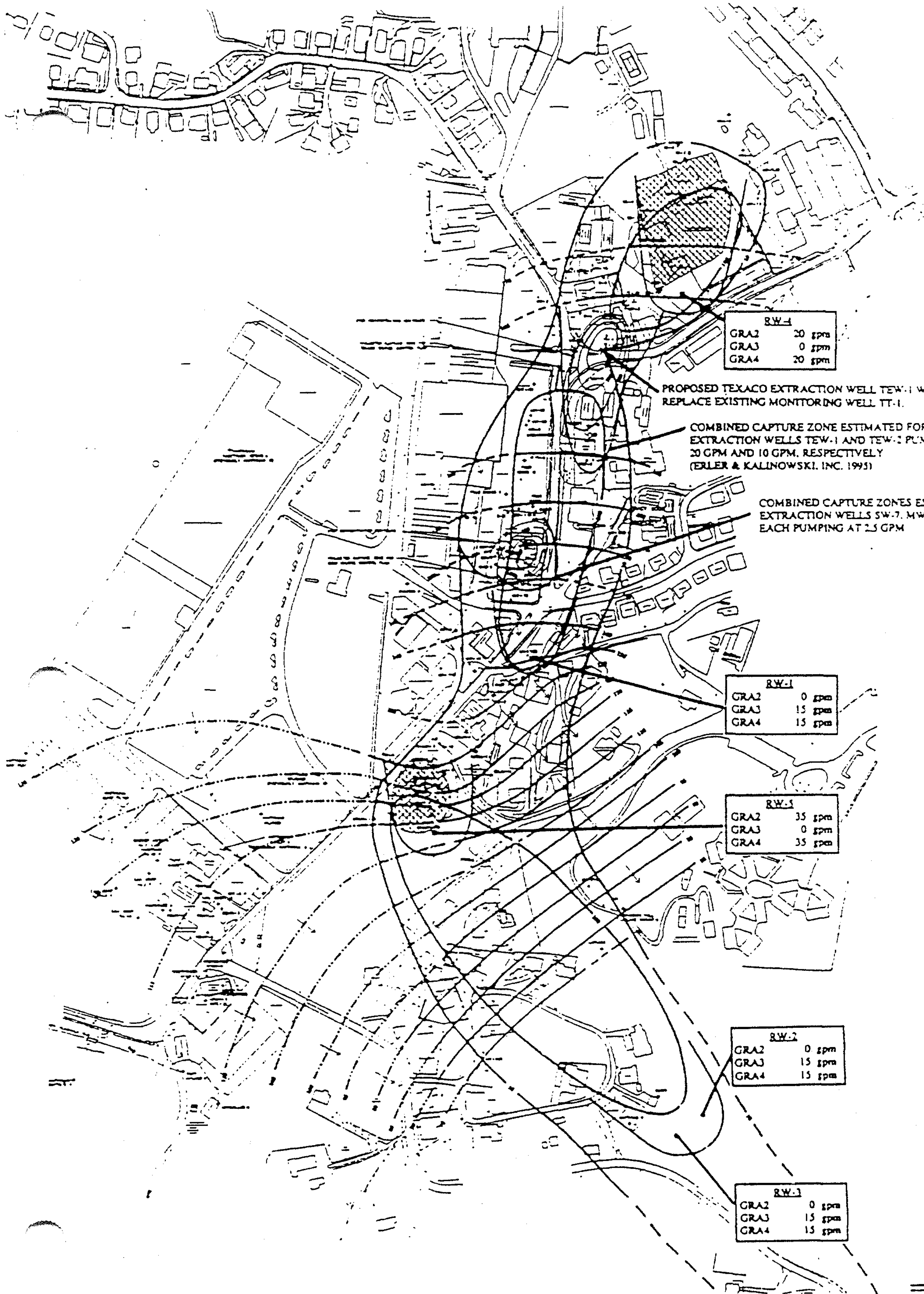
Source: Geraghty & Miller, Inc. Phase II RI, 1994.

TUTU WELLS SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

CDM FEDERAL PROGRAMS CORPORATION

Figure 4

TUT 008 0796



**CONCEPTUAL WELLS LOCATION (EXACT WELLS LOCATIONS WILL BE DECIDED DURING REMEDIAL DESIGN)

TUT 008 0797

TUTU WELLS SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

FEDERAL PROGRAMS CORPORATION

Figure 5

APPENDIX II

TABLES

Table 1 Summary of Analytes Detected in Soil above Soil Screening Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Property	Parameter	Depth (ft bls)	SSLs (ug/kg)	Sample Name	Sample Interval (ft bls)	Concentration (ug/kg)
Chlorinated VOC Constituents						
Curriculum Center	1,1,1-Trichloroethane	0.0 - 2.8	731	TWS-03	0.0 - 0.3	1,800
Esso Tutu Service Station	Tetrachloroethene	0.0 - 4.0	320	B-103	0.0 - 1.0	394
				SS-3	3.0	1,100
		4.0 - 15.0	32	SS-7	5.0	520
				SS-8	7.0	1,500
	1,1,1-Trichloroethane	4.0 - 15.0	32	SS-7	5.0	44
				SS-8	7.0	58
	Trichloroethene	4.0 - 15.0	32	SS-8	7.0	45
	1,1-Dichloroethane	0.0 - 4.0	320	SS-3	3.0	560
		4.0 - 15.0	32	SS-8	7.0	70
	1,2-Dichloroethene(trans)[1]	0.0 - 4.0	320	SS-3	3.0	3,200
		4.0 - 15.0	32	SS-7	5.0	75
				SS-8	7.0	110
O'Henry Dry Cleaners	Tetrachloroethene	0.0 - 1.6	375	e-01	(Surface Soil)	440,000 *
				e02-02	1.5 - 2.5	180,000
				OHSS-1	2.0	5,400 D
		1.7 - 22.0	31	OHSS-1	5.0	59,000 D
					8.0	400 J
				OHSS-1FR	5.0	22,000
				B-13	4.0 - 6.0	200 D
	Trichloroethene	1.7 - 22.0	31	e02-02	1.5 - 2.5	75
BTEX Constituents						
Curriculum Center	Benzene	0.0 - 2.8	150	SS-12	0.0 - 0.5	6,300 J
				TWS-03	0.0 - 0.3	2,700
	Toluene	0.0 - 2.8	150	SS-12	0.0 - 0.5	270,000
				TWS-03	0.0 - 0.3	500,000
	Ethylbenzene	0.0 - 2.8	150	SS-12	0.0 - 0.5	12,000 J
				TWS-03	0.0 - 0.3	47,000
	Xylenes	0.0 - 2.8	150	SS-12	0.0 - 0.5	77,000
				TWS-03	0.0 - 0.3	420,000
Ramsey Motors	Benzene	4.0 - 15.0	15	HB-2	4.5	17 J
	Ethylbenzene	0.0 - 4.0	74	HB-5	2.3	190 J
		4.0 - 15.0	15	HB-2	4.5	290

See last page for footnotes.

Table 1. Summary of Analytes Detected in Soil above Soil Screening Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Property	Parameter	Depth (ft bls)	SSLs (ug/kg)	Sample Name	Sample Interval (ft bls)	Concentration (ug/kg)
Texaco Tutu Service Station	Benzene	0.0 - 8.7	67	TT-1D	4.5 - 5.0	(170)
				TT-1D FR	4.5 - 5.0	69
	Ethylbenzene	0.0 - 8.7	67	OW/SB-1	6.5	(630)
				TT-1D	4.5 - 5.0	110 / (210)
				TT-1D FR	4.5 - 5.0	140
		8.7 - 15.0	13	OW/SB-1	9.5	67 / (50)
Esso Tutu Service Station	Benzene	0.0 - 4.0	74	SS-3	3.0	880
				TP-3	(Northeast Floor)	230 J
				TP-5	(Center Floor)	1,100
				TP-8	(South)	93
		4.0 - 15.0	15	B-102	10.0 - 12.0	625
				SS-7	5.0	160
				SS-8	7.0	270
	Toluene	0.0 - 4.0	74	SS-3	3.0	53,000
				SS-4	3.0	4,600
				SS-5	3.0	6,500
				SW-3	0.0 - 2.0	520
				TP-3	(Northeast Floor)	5,200
				TP-6	(East Floor)	180,000
		4.0 - 15.0	15	B-101	8.0 - 10.0	28
					10.0 - 12.0	548
				SS-1	9.0	46,000
				SS-7	5.0	33,000
				SS-8	7.0	51,000
	Ethylbenzene	0.0 - 4.0	74	SS-3	3.0	11,000
				SS-4	3.0	990
				SS-5	3.0	520
				SW-3	0.0 - 2.0	170
				TP-8	(South Wall)	520
				TP-5	(Center Floor)	7,000
				TP-6	(East Floor)	55,000
		4.0 - 15.0	15	B-101	10.0 - 12.0	304
				B-102	4.0 - 6.0	58
					8.0 - 10.0	1,117
					10.0 - 12.0	1,037
				B-103	7.0 - 7.5	26
				SS-1	9.0	12,000
				SS-7	5.0	1,700
				SS-8	7.0	11,000

See last page for footnotes.

Table 1. Summary of Analytes Detected in Soil above Soil Screening Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands

Property	Parameter	Depth (ft bls)	SSLs (ug/kg)	Sample Name	Sample Interval (ft bls)	Concentration (ug/kg)
Esso Tutu Service Station (continued)	Xylenes	0.0 - 4.0	74	SS-3	3.0	77,400
				SS-4	3.0	24,200
				SS-5	3.0	29,000
				SW-3	0.0 - 2.0	1,170
				TP-2	(North Floor)	1,600 E
				TP-3	(Northeast Floor)	31,000 E
				TP-6	(East Floor)	540,000
				TP-7	Southwest Floor	300 E
				TP-8	(South Wall)	220
		4.0 - 15.0	15	B-101	8.0 - 10.0	168
					10.0 - 12.0	2,295
				B-102	8.0 - 10.0	1,141
					10.0 - 12.0	575 **
				SS-1	9.0	80,400
				SS-7	5.0	58,000
				SS-8	7.0	78,000
Western Auto						
	Benzene	0.0 - 4.0	74	SS-1	2.0	140
		4.0 - 15.0	15	SS-6	5.0 - 6.0	34
				T1-2	4.0	29 J
	Toluene	0.0 - 4.0	74	SS-1	2.0	3,900
				T2-AS	0.0 - 0.5	760 J
				T2-ASRE	0.0 - 0.5	800 J
		4.0 - 15.0	15	MW-24-2	4.0 - 6.0	(34)
				T1-3	4.0	25 J
				T1-4	4.0	16 J
				T2-1S	6.7	28 J
				T2-3S	6.7	740 J
	Ethylbenzene	0.0 - 4.0	74	SS-1	2.0	1,600
				SS-2	3.0	850
				T2-AS	0.0 - 0.5	890 J
				T2-ASRE	0.0 - 0.5	1,000 J
				T2-SN	1.0 - 1.5	230
				T2-4S	1.0 - 1.5	150
		4.0 - 15.0	15	SS-4	5.0 - 6.0	37
				SS-5	5.0 - 6.0	100
				SS-6	5.0 - 6.0	420
				SS-7	5.0 - 6.0	270
				SS-8	5.0	340
				SS-9	5.0	290
				T1-1	4.0	100
				T1-2	4.0	240
				T1-3	4.0	20 J
				T1-4	4.0	18 J
				T2-1S	6.7	230
				T2-2S	6.7	29 J
				T2-3S	6.7	980 J

See last page for footnotes.

Table 1 Summary of Analytes Detected in Soil above Soil Screening Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Property	Parameter	Depth (ft bls)	SSLs (ug/kg)	Sample Name	Sample Interval (ft bls)	Concentration (ug/kg)
Western Auto (continued)	Xylenes	0.0 - 4.0	74	SS-1	2.0	34,000
				SS-2	3.0	501
				T2-AS	0.0 - 0.5	5,800
				T2-ASRE	0.0 - 0.5	6,100
				T2-SN	1.0 - 1.5	120
		4.0 - 15.0	15	SS-4	5.0 - 6.0	128
				SS-5	5.0 - 6.0	125
				SS-6	5.0 - 6.0	2,700
				SS-8	5.0	53
				T1-1	4.0	85
				T1-2	4.0	210
				T2-1S	6.7	430
				T2-2S	6.7	51 J
				T2-3S	6.7	7,000

SSLs based on USEPA-subcontractor (CDM Federal Programs Corp. 1995b) report on vadose zone modeling. Criteria are site-specific, except for data from soil samples collected from Western Auto and Ramsay Motors, which are screened against criteria applicable to the Esso Tutu Service Station.

Data reported in parentheses at Western Auto are from soil samples collected by ENSR Consulting & Engineering , Inc.

Data reported in parentheses at the Texaco Tutu Service Station are from soil samples collected by Blasland, Bouck & Lee, Inc.

*	Reported by the U.S. Environmental Protection Agency as tetrachloroethane; this is believed to be a typographical error.
**	Result includes only methylxylene; o- and p-xylene data not available.
(1)	1,2-Dichloroethene (1,2-DCE) results reported as total 1,2-DCE and SSL applies to the trans-1,2-DCE isomer.
SSLs	Soil Screening Levels. SSLs provided by the USEPA (CDM Federal Programs Corporation 1995b); see note above.
BTEX	Benzene, toluene, ethylbenzene, and xylenes.
FR	Field replicate.
VOC	Volatile organic compound.
J	Result detected below reporting limit and/or an estimated concentration.
D	Analyte identified at a secondary dilution.
E	Exceeds instrument calibration range.
ug/kg	Micrograms per kilogram, equivalent to parts per billion (ppb).
ft bls	Feet below land surface.
USEPA	U.S. Environmental Protection Agency.

Table 2. Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Volatile Organic Compounds					
Vinyl chloride	2	MW-3	--	48	--
		MW-15	--	260 D	--
		MW-16	--	1300	--
		TT-3D	--	9 J	--
		TT-5	--	42	--
1,2-Dichloroethene(total)*	100	CHT-7D	--	91	--
		DW-1	--	92 J	--
		La Place**	95	--	--
		MW-1	--	950 D	--
		MW-1D	--	500	--
		MW-3	--	440 D	--
		MW-4	--	76 J	--
		MW-6D	--	100	--
		MW-7	--	180	--
		MW-8	--	88 J	--
		MW-10	76 J	--	--
		MW-10D	110 J	--	--
		MW-15	--	1500 D	--
		MW-16	--	2100	--
		Steele**	100	--	--
		Tillett	360 D	--	--
		TT-2	--	330	--
		TT-2FR	--	330	--
		TT-3D	--	280	--
		TT-5	--	180	--
1,2-Dichloroethane	5	TT-1	--	290	--
Trichloroethene	5	MW-1	--	78	--
		MW-1D	--	71	--
		MW-3	--	17 J	--
		MW-4	--	6 J	--
		MW-6D	--	11	--
		MW-7	--	27	--
		MW-8	--	10 J	--
		MW-10	18 J	--	--
		MW-10D	14 J	--	--
		MW-12D	9 J	--	--
		MW-15	--	23	--
		MW-16	--	72 J	--
		MW-17	--	9 J	--
		MW-21D	--	14 J	--
		OHMW-4	16	--	--
		Smith	19 J	--	--
		Tillett	45	--	--
		TT-2	--	20 J	--
		TT-2 FR	--	20J	--
		TT-3D	--	15 J	--

See last page for footnotes.

Table 2. Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L)		
			5/94	6/94	7/94
Volatile Organic Compounds (continued)					
Benzene	5	CHT-3	--	1700	--
		KFC-1	--	110 J	--
		MW-5	--	460 DJ	--
		MW-7	--	21	--
		SW-2	--	550 J	--
		SW-3	--	10000 J	--
		SW-7	--	99 J	--
		SW-7 FR	--	110J	--
		TT-1	--	21000 D	--
		TT-1D	--	1700 D	--
		TT-4	--	21000	--
Tetrachloroethene	5	CHT-6D	--	12	--
		CHT-7D	--	36	--
		Delegarde	15 J	--	--
		DW-1	--	42 J	--
		DW-2	18	--	--
		MW-1	--	330 D	--
		MW-1D	--	360	--
		MW-3	--	56	--
		MW-4	--	20 J	--
		MW-4D	--	17 J	--
		MW-6D	--	31	--
		MW-6R	--	10	--
		MW-7	--	130	--
		MW-8	--	38 J	--
		MW-10	34 J	--	--
		MW-10D	48 J	--	--
		MW-12D	33 J	--	--
		MW-13D	--	28 J	--
		MW-15	--	120	--
		MW-16	--	71 J	--
		MW-17	--	37	--
		MW-20D	--	22 J	--
		MW-21D	--	45 J	--
		MW-25	--	11	--
		OHMW-1	10	--	--
		OHMW-2	26	--	--
		OHMW-3	6 J	--	--
		OHMW-4	140	--	--
		Ramsay	11	--	--
		Smith	110 J	--	--
		SW-4	--	15 J	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Volatile Organic Compounds (continued)					
Tetrachloroethene (continued)	5	Tillett	180	--	--
		TT-2	--	90	--
		TT-3	--	91	--
		TT-3D	--	23	--
Toluene	1000	SW-3	--	3200 J	--
		TT-1	--	16000 D	--
		TT-4	--	17000	--
Ethylbenzene	700	CHT-3	--	1800 D	--
		MW-5	--	760 DJ	--
		SW-3	--	4100 J	--
		TT-1	--	-3700 D	--
		TT-4	--	3300 J	--
Xylenes (total)	10000	SW-3	--	22000 J	--
		TT-1	--	18000 D	--
Inorganic Compounds/Analytes					
Aluminum	50 to 200	Four Winds II FR**	--	--	63.1 B
		Harvey**	--	--	111 B
		CHT-7D	--	118 B	--
		Delegarde	1890 B	--	--
		Gassett**	154 B	--	--
		MW-1	--	18600 J	--
		MW-6R	--	46400	--
		MW-7	--	10300	--
		MW-8	--	28700	--
		MW-9S	2050	--	--
		MW-10	956	--	--
		MW-10D	160 B	--	--
		MW-11D	147 B	--	--
		MW-12D	93.9	--	--
		MW-15	--	3730 J	--
		MW-17	--	33000 J	--
		MW-24	--	4160	--
		MW-25	--	15800	--
		OHMW-1	245000	--	--
		OHMW-2	8970	--	--
		OHMW-3	60000	--	--
		OHMW-4	356000	--	--
		Smith	60.9 B	--	--
		SW-5	12100	--	--
		SW-6	14500	--	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Inorganic Compounds/Analytes (continued)					
Aluminum (continued)	50 to 200	TT-1	--	6130 J	--
		TT-1D	--	153 B	--
		TT-2	--	1090 J	--
		TT-5	--	787 J	--
		DW-1	--	300	--
		DW-2	1490	--	--
Antimony	6	Four Winds II **	--	--	22 B
		KFC-1	--	18.6 BJ	--
		MW-1	--	17.6 B	--
		MW-2	--	15 B	--
		MW-3	--	17 B	
		MW-4	--	20.1 B	--
		MW-5	--	20.1 B	--
		MW-6D	--	25.3 B	--
		MW-7	--	21.3 B	--
		MW-13D	--	424 B	--
		MW-18	--	20.6 B	--
		MW-21D	--	19.6 B	--
		MW-22D	--	22.3 BJ	--
		OHMW-1	16.1 B	--	--
		OHMW-3	50.7 B	--	--
		SW-2	--	15.4 BJ	--
		SW-3	--	16.4 BJ	--
		SW-7	--	19.2 BJ	--
		SW-7FR	--	17.6 BJ	--
		TT-1	--	19.7 B	--
		TT-3D	--	19 B	--
		VIHA I **	--	--	20.6 B
Arsenic	50	OHMW-2	80.8	--	--
Barium	2000	MW-13D	--	4400 B	--
		OHMW-4	4320	--	--
Beryllium	4	MW-13D	--	40.8 B	--
Chromium	100	DW-2	628	--	--
		MW-1	--	453	--
		MW-2	--	619	--
		MW-6R	--	203	--
		MW-7	--	1050	--
		MW-8	--	210	--
		MW-13D	--	4300	--
		MW-17	--	238	--
		OHMW-1	2200	--	--
		OHMW-3	4610	--	--
		OHMW-4	397	--	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Inorganic Compounds/Analytes (continued)					
Copper	TT	MW-13D	--	1730 J	--
		OHMW-4	1370	--	--
Iron	300	Delegarde	4120 J	--	--
		DW-1	--	1150	--
		Gassett**	300	--	--
		Harvey**	--	--	2500
		DW-2	--	3100	--
		KFC-1	--	80000 J	--
		MW-1	--	25600	--
		MW-1D	--	10500	--
		MW-2	--	19900	--
		MW-3	--	3830	--
		MW-4	--	7590	--
		MW-4D	--	1440	--
		MW-5	--	5730	--
		MW-6R	--	56900	--
		MW-7	--	44800	--
		MW-8	--	49700	--
		MW-9S	3760	--	--
		MW-10	1410	--	--
		MW-10D	607	--	--
		MW-11D	323	--	--
		MW-12D	334	--	--
		MW-13	--	3670	--
		MW-13D	--	378000	--
		MW-15	--	5360	--
		MW-17	--	43500	--
		MW-18	--	68500 J	--
		MW-19	--	3420 J	--
		MW-20	--	23900	--
		MW-20D	--	37800	--
		MW-21D	--	19400	--
		MW-24	--	6890	--
		MW-25	--	30500	--
		OHMW-1	338000	--	--
		OHMW-2	15700	--	--
		OHMW-3	154000	--	--
		OHMW-4	572000	--	--
		SW-2	--	14100 J	--
		SW-3	--	108000 J	--
		SW-4	--	5140	--
		SW-5	18600	--	--
		SW-6	20300 J	--	--
		SW-7	--	14800 J	--
		Tillett	530	--	--
		TT-1	--	7810	--
		TT-1D	--	515	--
		TT-2	--	2320	--
		TT-5	--	1130	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Inorganic Compounds/Analytes (continued)					
Lead	TT	Gassett	167	--	--
		MW-1	--	27.1 J	--
		MW-9S	53.7	--	--
		MW-18	--	27.4	--
		MW-20	--	16	--
		MW-20D	--	20	--
		OHMW-1	48.3	--	--
		OHMW-2	201	--	--
		OHMW-3	17.3	--	--
		OHMW-4	71.8	--	--
		SW-3	--	143	--
		SW-7	--	70.8	--
		SW-7FR	--	93.8 J	--
Manganese	50	CHT-7D	--	282	--
		Delegarde	163 B	--	--
		Four Winds II **	--	--	125
		Four Winds II FR**	--	--	119
		Harvey**	267	--	--
		DW-2	620	--	--
		KFC-1	--	1030 J	--
		MW-1	--	570	--
		MW-1D	--	338	--
		MW-2	--	366	--
		MW-3	--	2540	--
		MW-4	--	1290	--
		MW-4D	--	55.1	--
		MW-5	--	1080	--
		MW-6R	--	736	--
		MW-7	--	453	--
		MW-8	--	2350	--
		MW-9S	2560	--	--
		MW-10	597	--	--
		MW-10D	216	--	--
		MW-12D	114	--	--
		MW-13	--	110	--
		MW-13D	--	20400	--
		MW-15	--	149	--
		MW-16	--	532	--
		MW-17	--	1550	--
		MW-18	--	3740 J	--
		MW-19	--	72.6 J	--
		MW-20	--	997	--
		MW-20D	--	1140	--
		MW-21D	--	402	--
		MW-24	--	215	--
		MW-25	--	982	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Inorganic Compounds/Analytes (continued)					
Manganese (continued)	50	OHMW-1	5870	--	--
		OHMW-3	3180	--	--
		OHMW-4	13500	--	--
		SW-2	--	943 J	--
		SW-3	--	6340 J	--
		TT-1	--	1710	--
		TT-1D	--	1880	--
		TT-2	--	1220	--
		TT-4	--	957	--
		TT-5	--	1110	--
Mercury	2	OHMW-1	3.1	--	--
Nickel	100	MW-4D	--	460	--
		DW-2	374	--	--
		MW-1	--	124	--
		MW-2	--	266	--
		MW-6R	--	127	--
		MW-7	--	445	--
		MW-8			--
		MW-10D	189	--	--
		MW-13D	--	2050	--
		MW-17	--	140	--
		OHMW-1	1120 J	--	--
		OHMW-3	1840 J	--	--
		OHMW-4	603 J	--	--
Thallium	2	DW-1	--	2.4 B	--
		MW-24	--	2.1 B	--
Chloride	250,000	Eglin I**	269	--	--
		Eglin III**	368	--	--
		Harvey**	--	--	1700
		Matthias**	294	--	--
		MW-21D	--	402	--
		OHMW-1	354	--	--
		OHMW-2	332	--	--
		OHMW-3	351	--	--
		Smith	335	--	--
		SW-5	378	--	--
Total Dissolved Solids	500,000	CHT-3	--	1320	--
		CHT-6D	--	850	--
		CHT-7D	--	870	--
		Dolegarde	1440	--	--
		DW-1	--	910	--
		DW-2	--	870	--
		Eglin I**	1180	--	--
		Eglin III**	1330	--	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameter	RAL (ug/L)	Well Designation	Concentration (ug/L) 5/94	6/94	7/94
Inorganic Compounds/Analytes (continued)					
Total Dissolved Solids (continued)	500,000	Four Winds I**	--	--	1240
		Gassett**	700	--	--
		Harthman Race Track	1100	--	--
		Harvey**	--	--	1190
		KFC-1	--	1070	--
		La Place**			
		Matthias**	1360	--	--
		MW-1	--	920	--
		MW-1D	--	880	--
		MW-2	--	910	--
		MW-3	--	900	--
		MW-4	--	920	--
		MW-4D	--	1180	--
		MW-5	--	810	--
		MW-6D	--	840	--
		MW-6R	--	910	--
		MW-7	--	760	--
		MW-8	--	920	--
		MW-9S	830	--	--
		MW-10	790	--	--
		MW-12D	640	--	--
		MW-13	--	900	--
		MW-13D	--	1520	--
		MW-15	--	990	--
		MW-17	--	870	--
		MW-18	--	800	--
		MW-19	--	1040	--
		MW-20	--	500	--
		MW-20D	--	780	--
		MW-21D	--	2260	--
		MW-22D	--	1890	--
		MW-24	--	940	--
		MW-25	--	950	--
		OHMW-1	354	--	--
		OHMW-2	1110	--	--
		OHMW-3	1290	--	--
		OHMW-4	1040	--	--
		Ramsay	870	--	--
		Smith	335	--	--
		SW-5	378	--	--
Nitrate (as N) (mg/L)	10,000	Gassett**	11.3	--	--
		Harthman Race Track	13.6	--	--
		MW-1	--	12.4	--
		MW-2	--	15.9	--
		MW-13	--	10.6	--
		MW-17	--	22.7	--
		MW-24	--	13.3	--
		Ramsay	10	--	--

See last page for footnotes.

Table 2 Summary of Analytes Detected in Groundwater Above Remedial Action Levels at the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

*	Analytical results reported for total isomers (cis- and trans-) for 1,2-dichloroethene (1,2-DCE); RAL is for trans- isomer.
**	Sample results were not validated.
--	Not available.
mg/L	Milligrams per liter.
ug/L	Micrograms per liter.
B	The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).
J	Estimated value.
D	Compound concentration was determined at a secondary dilution factor.
RAL	Remedial Action Level.
TT	Treatment technique. (Action Levels: Copper 1,300 ug/L, lead 15 ug/L). Values in parentheses are determined by the USEPA.
USEPA	U.S. Environmental Protection Agency.

Note: RALs derived from Federal Drinking Water Standards.

12/9/94
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TABLE 3

TUTU WELLS SITE
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN IN SITE MATRICES BY AREA OF CONCERN

SURFACE SOIL

Tillett Gardens and Art Center	Fire Dept./Texaco Gas Station/Antilles Auto Parts/Ramsay Motor Co.	Curriculum Center Building (Present)	Curriculum Center Building (Future)	O'Henry Dry Cleaners and Liquor Barn
VOCs:	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*
None Selected	None Selected	None Selected	None Selected	Tetrachloroethene
SVOCs:	*SVOCs:*	*SVOCs:*	*SVOCs:*	*SVOCs:*
None Selected	Benzo(b)fluoranthene Benzo(a)pyrene	2-Methylphenol 4-Methylphenol	2-Methylphenol 4-Methylphenol	None Selected
Pesticides/PCBs:	*Pesticides/PCBs:*	*Pesticides/PCBs:*	*Pesticides/PCBs:*	*Pesticides/PCBs:*
Aroclor 1242	None Selected	None Selected	None Selected	None Selected
Inorganics:	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*
Antimony Arsenic Manganese Vanadium	Antimony Beryllium Manganese Vanadium	Antimony Arsenic Beryllium Manganese Vanadium	Antimony Arsenic Beryllium Manganese Vanadium	Antimony Arsenic Manganese Vanadium

TUT 008 0812

TUT 008 0813

TABLE 3 (Cont'd)

TUTU WELLS SITE
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN IN SITE MATRICES BY AREA OF CONCERN

	SUBSURFACE SOIL					GROUNDWATER
	Tillett Gardens and Art Center	Fire Dept./Texaco Gas Station/Antilles Auto Parts/Ramsay Motor Co.	Curriculum Center Building (Future)	Esso Gas Station and Splash and Dash Car Wash	O'Henry Dry Cleaners and Liquor Barn	Site-Wide
VOCs:	None Selected	None Selected	None Selected	None Selected	None Selected	Benzene 1,2 Dichloroethene (Total) Tetrachloroethene Toluene Vinyl Chloride
SVOCs:	Benzo(a)pyrene	Benzo(a)pyrene	None Selected	None Selected	None Selected	None Selected
Pesticides/PCBs:	Not Analyzed	None Selected	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
Inorganics:	Antimony Arsenic Beryllium Manganese Vanadium	Antimony Arsenic Barium Beryllium Manganese Vanadium	Antimony Arsenic Beryllium Manganese Vanadium	Antimony Arsenic Beryllium Manganese Vanadium	Antimony Arsenic Manganese Vanadium	Antimony Arsenic Beryllium Chromium VI Manganese Nickel Vanadium

CHEMICALS OF POTENTIA' NCERN FOR SITE SURFACE SOILS
TL ELLS SITE

	Frequency of Detection	Range of Detected Concentrations Minimum	-	Maximum	Location of Maximum	Range of Non-Detect Concentrations Minimum	-	Maximum
CHEMICALS								
VOCs (ug/kg)								
Methylene Chloride	1/16	---	-	1.0 J	MWS-16-AVD	8 UJ	-	14000 UB
2-Butanone	1/17	---	-	44.5 J	SS-3-AVS	11 UJ	-	11000 U
Trichloroethylene	2/19	1.0 J	-	65 J	SS-3-AVS	6.0 U	-	14000 U
Benzene	2/19	6.0 J	-	45 J	eC-10S	6.0 U	-	14000 U
4-Methyl-2-pentanone	2/19	8.0 J	-	33 J	eC-10S	11 U	-	27000 U
Tetrachloroethylene	5/19	15	-	440000	e-01	6.0 U	-	880 U
Toluene	5/19	2.0 J	-	1300	eC-10S	6.0 U	-	14000 UJ
Ethylbenzene	5/19	3.0 J	-	2100	eC-10S	6.0 U	-	14000 UJ
Xylenes(Total)	9/20	1.0 J	-	5600	eC-10S	6.0 UJ	-	14000 UJ
SVOCs (ug/kg)								
Phenol	2/12	39 NJ	-	900000	eL-02-01S	350 U	-	11000 UJ
2-Methylphenol	1/12	---	-	320000	eL-02-01S	350 U	-	11000 UJ
4-Methylphenol	1/12	---	-	1300000 J	eL-02-01S	350 U	-	11000 UJ
2,4-Dimethylphenol	1/12	---	-	42000 J	eL-02-01S	350 U	-	11000 UJ
Benzoic acid	1/7	---	-	63 JN	SS-6-AVS	1800 U	-	380000 U
Naphthalene	3/13	4100	-	7700 J	eL-02-01S	350 U	-	1300 UJ
Acenaphthene	1/13	---	-	190 J	eR-02-02S	350 U	-	78000 U
Fluorene	1/13	---	-	420 J	eR-02-02S	350 U	-	78000 U
Di-n-butylphthalate	3/13	52 J	-	9400 J	SS-3-AVS	34 J	-	78000 U
Fluoranthene	2/13	100 J	-	740 J	eR-02-02S	350 U	-	78000 U
Pyrene	3/13	76 J	-	2000	eR-02-02S	350 U	-	78000 U
Chrysene	1/13	---	-	59 J	SS-5-AVS	350 U	-	78000 U
Bis(2-ethylhexyl)phthalate	1/13	---	-	5400	eR-02-02S	136 UBJ	-	78000 U
Benzo(b)fluoranthene	2/13	84 J	-	870 J	eR-02-02S	350 U	-	78000 U
Benzo(a)pyrene	2/13	270 J	-	770 J	eR-02-02S	350 U	-	78000 U
Benzo(g,h,i)perylene	3/13	82 J	-	430 J	eR-02-02S	350 U	-	78000 U

CHEMICALS OF POTENTIAL [illegible]CERN FOR SITE SURFACE SOILS
TUT[illegible]ELLS SITE

	Frequency of Detection	Range of Detected Concentrations Minimum		Range of Detected Concentrations Maximum	Location of Maximum	Range of Non-Detect Concentrations Minimum		Range of Non-Detect Concentrations Maximum
CHEMICALS								
PESTICIDES/PCBs (ug/kg)								
Endosulfan I	1/13	---	-	92	eL-02-01S	9 U	-	1700 UJ
Aroclor-1242	1/13	---	-	120000 J	eTT-15S	90 U	-	1100 UJ
INORGANICS and CYANIDE (mg/kg)								
Aluminum	3/7	21100	-	27350	MWS-16-AVD	21300	-	26950
Antimony	1/7	---	-	5.9 BJ	B-2	4.08 UBNJ	-	6.35 UBNJ
Arsenic	2/7	2.1	-	13.7	B-13A	1.46 UBWJ	-	18.65 UJ
Barium	3/7	33.0 B	-	67.2	B-2	44.2 UB	-	96.25 U
Cadmium	1/7	---	-	0.7 B	MWS-16-AVD	0.48 U	-	0.7 U
Chromium	3/7	23.6	-	42.2 J	MWS-16-AVD	19.93 UNJ	-	33.95 UNJ
Cobalt	3/7	16.3	-	25.55 J	MWS-16-AVD	13.85 UJ	-	22.75 UJ
Copper	3/7	52	-	108.7	MWS-16-AVD	54.95 UJ	-	79.65 UNJ
Iron	3/7	29400	-	38400	B-2	27725 J	-	48800
Lead	4/7	3.1	-	86.35 SJ	SS-5-AVS	11.3 J	-	19.95 J
Manganese	3/7	834	-	872	MWS-16-AVD	699.5 UJ	-	886 U
Nickel	3/7	14.7	-	21.7	MWS-16-AVD	11.5 UJ	-	18.15 U
Sodium	2/7	319 B	-	470 B	B-13A	273.25 UBJ	-	488.50 UB
Vanadium	3/7	83.1	-	119	B-2	72.65 UNJ	-	96.50 UNJ
Zinc	3/7	52.0	-	108	B-2	95.75 UJ	-	318
Cyanide, total	1/7	---	-	1.1	B-2	0.53 U	-	0.64 U

CHEMICALS OF POTENTIA' NCERN FOR SITE SURFACE SOILS
TL ELLS SITE

EPA Data Qualifiers:
U - Analyte was analyzed for but not detected
J - Estimated value
B - For organic parameters:
Compound found in the associated blank as well as in the sample
For Inorganic parameters:
Reported value was obtained from a reading that was less than the Contract Required Detection Limit, but greater than or equal to the Instrument Detection Limit
N - Presumptive evidence of a compound
S - The reported value was determined to by the Method of Standard Additions
W - Post-digestion spike for Furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance
* - Duplicate analysis not within control limits

TUTU WE[illegible]ITE
POTENTIAL EXPOS[illegible]E PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
PRESENT - USE SCENARIOS:				
Surface Soil				
	Site Residents (Adults and Children) (Tillett Gardens and Art Center)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes No No	Site residents are expected to come into direct contact with surface soil in the vicinity of their home and Tillett Gardens and Art Center. The inhalation of particulates from surface soil is assumed to be negligible, as the areas where samples were collected either consist of hard packed soil or are covered by vegetation. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation pathways were therefore not selected for further evaluation.
	Site Workers 1- (Employees of the Fire Dept., Texaco gas station, Antilles auto parts, and Ramsay motor company)**	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes No No	Site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The inhalation of particulates from surface soil is assumed to be negligible, as the areas where samples were collected consist of either hard packed soil or are covered to a large extent by vegetation. The inhalation of VOCs is also asumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation pathways were therefore not selected for further evaluation.
	2- (Employees of the Curriculum Center Building)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes No No	Site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The inhalation of particulates from surface soil is assumed to be negligible, as the areas where samples were collected consist of either hard packed soil or are covered to a large extent by vegetation. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation pathways were therefore not selected for further evaluation.
	3- (Employees of the Esso gas station and the Splash and Dash car wash)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	Since the Esso gas station and Splash and Dash car wash properties are completely paved, no surface soil is available for contact. Therefore, no surface soil exposure can occur.
	4- (Employees of O'Henry dry cleaners and Liquor Barn)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes No Yes	Site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The inhalation of particulates from surface soil is assumed to be negligible, as the area where samples were collected is covered to a large extent by dense vegetation. Since a VOC was selected as a chemical of potential concern for this area, the inhalation of VOCs pathway was retained for further evaluation.

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TUTU W[illegible] SITE
POTENTIAL EXPO[illegible]E PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
PRESENT - USE SCENARIOS CONT'D:				
Surface Soil (Cont'd)				
	Construction Workers (Site-Wide)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	No construction work is currently in progress in any areas of concern at the site.
Subsurface Soil				
	Site Residents (Adults and Children) (Tillett Gardens and Art Center)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	No construction work (i.e., excavation activity) is currently in progress in this area of the site.
	Site Workers 1- (Employees of the Fire Dept., Texaco gas station, Antilles auto parts, and Ramsay motor company)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	No construction work (i.e., excavation activity) is currently in progress in this area of the site.
	2- (Employees of the Curriculum Center Building)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	No construction work (i.e., excavation activity) is currently in progress in this area of the site.
	3- (Employees of the Esso gas station and the Splash and Dash car wash)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	No construction work (i.e., excavation activity) is currently in progress in this area of the site.
	4- (Employees of O'Henry dry cleaners and Liquor Barn)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	No construction work (i.e., excavation activity) is currently in progress in this area of the site.
	Construction Workers (Site-Wide)	Ingestion Dermal Contact* Inhalation of Particulates	No No No	No construction work (i.e., excavation activity) is currently in progress in any areas of concern at the site.

TABLE 5

TUTU WE SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
PRESENT - USE SCENARIOS CONT'D:				
Groundwater				
	Site Residents (Adults and Children)	Ingestion Dermal Contact (Shower) Inhalation of VOCs (Shower)	Yes Yes Yes	Currently, an order against drinking and bathing in groundwater at the site has been issued. However, since evidence of pumping exists at the Ramsay well, residents may be using the groundwater for these purposes in addition to secondary purposes such as clothes washing, lawn watering, etc.
	Site Workers (All)	Ingestion Dermal Contact (Shower) Inhalation of VOCs (Shower)	Yes No No	Currently, an order against drinking and bathing in groundwater at the site has been issued. However, since evidence of pumping exists at the Ramsay well, site workers may be using the groundwater for drinking. Site workers are not expected to shower on-site.
	Construction Workers (Site-Wide)	Ingestion Dermal Contact (Shower) Inhalation of VOCs (Shower)	No No No	No construction work (i.e., excavation activity) is currently in progress in any areas of concern at the site.
FUTURE - USE SCENARIOS:				
Surface Soil				
	Residents (Adults and Children) (Tillett Gardens and Art Center)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes Yes No	Site residents are expected to come into direct contact with surface soil in the vicinity of their home and Tillett Gardens and Art Center. The inhalation of particulates exposure route may be of concern due to the potential for future construction work (i.e., excavation activity) in this area. The inhalation of VOCs is assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
	Site Workers 1- (Employees of the Fire Dept., Texaco gas station, Antilles auto parts, and Ramsay motor company)**	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes Yes No	Site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The inhalation of particulates exposure route may be of concern due to the potential for future construction work (i.e., excavation activity) in this area. The inhalation of VOCs is assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.

TUTU WE[illegible] SITE
POTENTIAL EXP[illegible]E PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS CONT'D:				
Surface Soil (Cont'd)				
	2- (Employees of the Curriculum Center Building)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes Yes No	Site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The inhalation of particulates exposure route may be of concern due to the potential for future construction work (i.e., excavation activity) in this area. The inhalation of VOCs is assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
	3- (Employees of the Esso gas station and the Splash and Dash car wash)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No No No No	Since the Esso gas station and Splash and Dash car wash properties are completely paved, no surface soil would be available for contact. Therefore, no surface soil exposure can occur.
	4- (Employees of O'Henry dry cleaners and Liquor Barn)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes Yes Yes	Site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The inhalation of particulates exposure route may be of concern due to the potential for future construction work (i.e., excavation activity) in this area. Since a VOC was selected as a chemical of potential concern for this area, the inhalation of VOCs pathway was retained for further evaluation.
	Construction Workers (Tillett Gardens and Art Center)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes Yes No	The potential exists for further commercial or residential development of the Tillett Gardens and Art Center area of concern. Construction workers would be expected to routinely contact surface soil during excavation activities. The inhalation of particulates exposure route may also be of concern as a result of this activity. The inhalation of VOCs is assumed to be negligible as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
Subsurface Soil				
	Residents (Adults and Children) (Tillett Gardens and Art Center)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No Yes Yes No	During potential future construction work (i.e., excavation activity), residents may come into direct contact with exposed subsurface soil. However, they are assumed to ingest a negligible amount of excavated subsurface soil. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.

TABLE 3

TUTU WE[illegible]ITE
POTENTIAL EXPOS[illegible]E PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS CONT'D:				
Subsurface Soil (Cont'd)				
	Site Workers 1- (Employees of the Fire Dept., Texaco gas station, Antilles auto parts, and Ramsay motor company)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No Yes Yes No	During potential future construction work (i.e., excavation activity), site workers may come into direct contact with exposed subsurface soil. However, they are assumed to ingest a negligible amount of excavated subsurface soil. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
	2- (Employees of the Curriculum Center Building)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No Yes Yes No	During potential future construction work (i.e., excavation activity), site workers may come into direct contact with exposed subsurface soil. However, they are assumed to ingest a negligible amount of excavated subsurface soil. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
	3- (Employees of the Esso gas station and the Splash and Dash car wash)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No Yes Yes No	During potential future construction work (i.e., excavation activity), site workers may come into direct contact with exposed subsurface soil. However, they are assumed to ingest a negligible amount of excavated subsurface soil. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
	4- (Employees of O'Henry dry cleaners and Liquor Barn)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	No Yes Yes No	During potential future construction work (i.e., excavation activity), site workers may come into direct contact with exposed subsurface soil. However, they are assumed to ingest a negligible amount of excavated subsurface soil. The inhalation of VOCs is also assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.
	Construction Workers (Tillett Gardens and Art Center)	Ingestion Dermal Contact* Inhalation of Particulates Inhalation of VOCs	Yes Yes Yes No	The potential exists for further commercial or residential development of the Tillett Gardens and Art Center area of concern. Construction workers would be expected to routinely contact subsurface soil during excavation activities. The inhalation of particulates exposure route may also be of concern as a result of this activity. The inhalation of VOCs is assumed to be negligible, as no VOCs were selected as chemicals of potential concern. The inhalation of VOCs pathway was therefore not selected for further evaluation.

TABLE 5

TUTU WI SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS CONT'D:				
Groundwater				
	Site Residents (Adults and Children)	Ingestion Dermal Contact (Shower) Inhalation of VOCs(Shower)	Yes Yes Yes	Currently, an order against drinking and bathing in groundwater at the site has been issued. However, since evidence of pumping exists at the Ramsay well, residents may continue to use the groundwater in the future for these purposes in addition to secondary purposes such as clothes washing, lawn watering.
	Site Workers (All)	Ingestion Dermal Contact (Shower) Inhalation of VOCs (Shower)	Yes No No	Currently, an order against drinking and bathing in groundwater at the site has been issued. However, since evidence of pumping exists at the Ramsay well, site workers may continue to use the groundwater in the future for drinking. Site workers are not expected to shower on-site.
	Construction Workers	Ingestion Dermal Contact (Shower) Inhalation of VOCs (Shower)	Yes No No	Currently, an order against drinking and bathing in groundwater at the site has been issued. However, since evidence of pumping exists at the Ramsay well, construction workers may continue to use the groundwater in the future for drinking. Construction workers are not expected to shower on-site.

*The dermal contact pathway can only be quantitatively evaluated for PCBs and cadmium as only these chemicals have established dermal absorption factors (PCBs = 6% and cadmium = 1%). All other chemicals will be qualitatively discussed.

**It should be noted that present and potential future site workers at the Fire Department and Texaco gas station were not considered receptors for surface soil since no surface soil samples were collected at the Fire Department, and the Texaco gas station is completely paved (all soil samples would be subsurface). However, all individual areas in the area of concern are listed to be consistent with those listed for the subsurface soil area of concern.

TABLE 8

TUTU WELLS SITE
CHRONIC TOXICITY VALUES: POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Volatile Organics				
Acetone	1.0E-01	1000	-	-
Benzene	-	-	-	-
Bromodichloromethane	2.0E-02	1000	-	-
Bromoform	2.0E-02	1000	-	-
Bromomethane	1.4E-03	1000	1.4E-03	100
2-Butanone	6.0E-01	3000	2.9E-01	1000
Carbon Disulfide	1.0E-01	100	2.9E-03 (2)	1000
Chlorobenzene	2.0E-02	1000	5.7E-03 (3)	10000
Chloroform	1.0E-02	1000	-	-
Chloromethane	-	-	-	-
Dibromochloromethane	2.0E-02	1000	-	-
1,1-Dichloroethane	1.0E-01 (2)	1000	1.4E-01 (3)	1000
1,2-Dichloroethane	-	-	-	-
1,1-Dichloroethene	9.0E-03	1000	-	-
cis 1,2-Dichloroethene	1.0E-02 (2)	3000	-	-
1,2-Dichloroethene (Total)	9.0E-03 (2)	1000	-	-
Ethylbenzene	1.0E-01	1000	2.9E-01	300
2-Hexanone	-	-	-	-
Methyl-tert-Butyl-Ether	-	-	9.0E-01	100
4-Methyl-2-Pentanone	8.0E-02 (2)	3000	2.3E-02 (3)	1000
Methylene Chloride	6.0E-02	100	8.6E-01 (2)	100
n-Propylbenzene	-	-	-	-
Tetrachloroethene	1.0E-02	1000	-	-
Toluene	2.0E-01	1000	1.1E-01	300
1,1,1-Trichloroethane	-	-	-	-
1,1,2-Trichloroethane	4.0E-03	1000	-	-
Trichloroethene	6.0E-03 (4)	3000	-	-
Vinyl Chloride	-	-	-	-
Xylenes (Total)	2.0E+00	100	-	-
Semivolatile Organics				
Acenaphthene	6.0E-02	3000	-	-
Acenaphthylene	-	-	-	-
Anthracene	3.0E-01	3000	-	-
Benzoic Acid	4.0E+00	1	-	-
Benzo(a)anthracene	-	-	-	-
Benzo(a)pyrene	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-
Bis(2-chloroethyl)ether	-	-	-	-
Bis(2-ethylhexyl)phthalate	2.0E-02	1000	-	-
Butylbenzylphthalate	2.0E-01	1000	-	-
Carbazole	-	-	-	-

TUTU WELLS SITE
CHRONIC TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Semivolatile Organics (Cont'd)				
Chrysene	-	-	-	-
Di-n-butylphthalate	1.0E-01	1000	-	-
Di-n-octylphthalate	2.0E-02 (2)	1000	-	-
Dibenzofuran	-	-	-	-
1,2-Dichlorobenzene	9.0E-02	1000	5.7E-02 (3)	1000
1,4-Dichlorobenzene	-	-	2.3E-01	100
Diethylphthalate	8.0E-01	1000	-	-
2,4-Dimethylphenol	2.0E-02	3000	-	-
Dimethylphthalate	1.0E+01 (2)	100	-	-
Fluoranthene	4.0E-02	3000	-	-
Fluorene	4.0E-02	3000	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-
2-Methylnaphthalene	-	-	-	-
2-Methylphenol	5.0E-02 (4)	1000	-	-
4-Methylphenol	5.0E-03 (2)	1000	-	-
2-Nitrophenol	-	-	-	-
Naphthalene	4.0E-02 (4)	1000	-	-
Phenanthrene	-	-	-	-
Phenol	6.0E-01	100	-	-
Phthalic Anhydride (TIC)	2.0E+00	1000	3.4E-02 (2)	300
Pyrene	3.0E-02	3000	-	-
1,2,4-Trichlorobenzene	1.0E-02	1000	5.7E-02 (2)	1000
Pesticides/PCBs				
Chlordane	6.0E-05	1000	-	-
Endosulfan	6E-03 (2)	100	-	-
PCBs (Aroclors)	-	-	-	-
Inorganics				
Aluminum	-	-	-	-
Antimony	4.0E-04	1000	-	-
Arsenic	3.0E-04	3	-	-
Barium	7.0E-02	3	1.4E-04 (3)	1000
Beryllium	5.0E-03	100	-	-
Cadmium (food)	1.0E-03	10	-	-
Cadmium (water)	5.0E-04	10	-	-
Chromium III	1.0E+00	100	-	-
Chromium VI	5.0E-03	500	-	-
Cobalt	-	-	-	-
Copper*	-	-	-	-
Cyanide	2.0E-02	100	-	-
Lead (and compounds-inorg.)	-	-	-	-

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TABLE 8

TUTU WELLS SITE
CHRONIC TOXICITY VALUES POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Inorganics				
Manganese (water)	5.0E-03	1	1.4E-05	1000
Mercury	3.0E-04 (2)	1000	8.6E-05 (2)	30
Nickel (sol. salt)	2.0E-02	300	-	-
Selenium	5.0E-03	3	-	-
Silver	5.0E-03	3	-	-
Thallium (chloride)	8.0E-05	3000	-	-
Vanadium	7.0E-03 (2)	100	-	-
Zinc (and compounds)	3.0E-01	3	-	-

NOTES:

- Calcium, iron, magnesium, potassium, and sodium are considered essential nutrients and will not be quantitatively evaluated in the risk assessment.

*The current drinking water standard for copper is 1.3 mg/l. The DWCD (1987) concluded that toxicity data are inadequate for calculation *of a reference dose for this chemical*

(1) All toxicity values obtained from IRIS (on-line June 22 and 30, 1994, July 1, 1994, August 4, 1994, and December 6, 1994) unless otherwise noted.
(2) Toxicity values obtained from HEAST Annual FY-1994.
(3) Toxicity values obtained from HEAST Annual FY-1994: Toxicity values are found in USEPA documents but were calculated by *alternative methods not currently practiced by the RfD Work Group.*
(4) Toxicity values were originally obtained from the Superfund Health Risk Technical Support Center, September 27, 1993. These values were confirmed by the USEPA Risk Assessment Specialist.
(5) The endosulfan toxicity values are reported, as none are available for the endosulfan I isomer.

USEPA WEIGHT - OF - EVIDENCE:

A - Human Carcinogen
B1 - Probable Human Carcinogen. Limited human data are available.
B2 - Probable Human Carcinogen. Sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans.
C - Possible Human Carcinogen
D - Not Classifiable as to human carcinogenicity.
E - Evidence of noncarcinogenicity for humans.

TABLE 7

TUTU WELLS SITE
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	CARCINOGENS: SLOPE FACTORS (SF)		
	Oral SF (mg/kg-day)-1	Inhalation SF (mg/kg-day)-1	Weight-of-Evidence
Volatile Organics			
Acetone	-	-	D
Benzene	2.9E-02	2.9E-02	A
Bromodichloromethane	6.2E-02	-	B2
Bromoform	7.9E-03	3.9E-03	B2
Bromomethane	-	-	D
2-Butanone	-	-	D
Carbon Disulfide	-	-	-
Chlorobenzene	-	-	D
Chloroform	6.1E-03	8.1E-02	B2
Chloromethane	1.3E-02 (2)	6.3E-03 (2)	C
Dibromochloromethane	8.4E-02	-	C
1,1-Dichloroethane	-	-	C
1,2-Dichloroethane	9.1E-02	9.1E-02	B2
1,1-Dichloroethene	6.0E-01	1.8E-01	C
cis 1,2-Dichloroethene	-	-	D
1,2-Dichloroethene (Total)	-	-	-
Ethylbenzene	-	-	-
2-Hexanone	-	-	-
Methyl-tert-Butyl-Ether	-	-	-
4-Methyl-2-Pentanone	-	-	-
Methylene Chloride	7.5E-03	1.6E-03	B2
n-Propylbenzene	-	-	-
Tetrachloroethene	5.2E-02 (3)	2.0E-03 (3)	C-B2
Toluene	-	-	D
1,1,1-Trichloroethane	-	-	D
1,1,2-Trichloroethane	5.7E-02	5.6E-02	C
Trichloroethene	1.1E-02 (3)	6.0E-03 (3)	B2
Vinyl Chloride	1.9E+00 (2)	3.0E-01 (2)	A
Xylenes (Total)	-	-	D
Semivolatile Organics			
Acenaphthene	-	-	-
Acenaphthylene	-	-	D
Anthracene	-	-	D
Benzoic Acid	-	-	D
Benzo(a)anthracene	7.3E-01*	-	B2
Benzo(a)pyrene	7.3E+00	-	B2
Benzo(b)fluoranthene	7.3E-01*	-	B2
Benzo(g,h,i)perylene	-	-	D
Benzo(k)fluoranthene	7.3E-02*	-	B2
Bis(2-chloroethyl)ether	1.1E+00	1.1E+00	B2
Bis(2-ethylhexyl)phthalate	1.4E[illegible]	-	B2
Butylbenzylphthalate	[illegible]	-	C

TABLE 7

TUTU WELLS SITE
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	CARCINOGENS: SLOPE FACTORS (SF)		
	Oral SF (mg/kg-day)-1	Inhalation SF (mg/kg-day)-1	Weight-of-Evidence
Semivolatile Organics (Cont'd)			
Carbazole	2.0E-02 (2)	-	B2
Chrysene	7.3E-03*	-	B2
Di-n-butylphthalate	-	-	D
Di-n-octylphthalate	-	-	-
Dibenzofuran	-	-	D
1,2-Dichlorobenzene	-	-	D
1,4-Dichlorobenzene	2.4E-02 (2)	-	B2
Diethylphthalate	-	-	D
2,4-Dimethylphenol	-	-	-
Dimethylphthalate	-	-	D
Fluoranthene	-	-	D
Fluorene	-	-	D
Indeno(1,2,3-cd)pyrene	7.3E-01*	-	B2
2-Methylnaphthalene	-	-	-
2-Methylphenol	-	-	C
4-Methylphenol	-	-	C
Naphthalene	-	-	D
2-Nitrophenol	-	-	-
Phenanthrene	-	-	D
Phenol	-	-	D
Phthalic Anhydride (HC)	-	-	-
Pyrene	-	-	D
1,2,4-Trichlorobenzene	-	-	D
Pesticides/PCBs			
Chlordane	1.3E+00	1.3E+00	B2
Endosulfan (4)	-	-	-
PCBs (Aroclors)	7.7E+00	-	B2
Inorganics			
Aluminum	-	-	-
Antimony	-	-	-
Arsenic	1.75E+00	1.5E+01	A
Barium	-	-	-
Beryllium	4.3E+00	8.4E+00	B2
Cadmium	-	6.3E+00	B1
Chromium III	-	-	-
Chromium VI	-	4.2E+01	A
Cobalt	-	-	-
Copper**	-	-	D
Cyanide	-	-	D
Lead (and compounds-inorg.)	-	-	B2
Manganese (water)	-	-	D

TABLE 7

TUTU WELLS SITE
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	CARCINOGENS: SLOPE FACTORS (SF)		
	Oral SF (mg/kg-day)-1	Inhalation SF (mg/kg-day)-1	Weight-of-Evidence
Inorganics (Cont'd)			
Mercury	-	-	D
Nickel (sol. salt)	-	-	-
Selenium	-	-	D
Silver	-	-	D
Thallium (chloride)	-	-	D
Vanadium	-	-	-
Zinc (and compounds)	-	-	D

NOTES:

- Calcium, iron, magnesium, potassium, and sodium are considered essential nutrients and will not be quantitatively evaluated in the risk assessment.

*Relative Potency Values were used in conjunction with slope factors per USEPA Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (July 1993).

**The current drinking water standard for copper is 1.3 mg/l. The DWCD (1987) concluded that toxicity data are inadequate for calculation of a reference dose for this chemical.

(1) All toxicity values obtained from IRIS (on-line June 22 and 30, 1994, July 1, 1994, August 4, 1994, and December 6, 1994) unless otherwise noted.
(2) Toxicity values obtained from HEAST Annual FY-1994.
(3) Toxicity values were originally obtained from the Superfund Health Risk Technical Support Center, September 27, 1993. These values were confirmed by the USEPA Risk Assessment Specialist.
(4) The endosulfan toxicity values are reported, as none are available for the endosulfan I isomer.

USEPA WEIGHT - OF - EVIDENCE:

A - Human Carcinogen.
B1 - Probable Human Carcinogen. Limited human data are available.
B2 - Probable Human Carcinogen. Sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans.
C - Possible Human Carcinogen.
D - Not Classifiable as to human carcinogenicity.
E - Evidence of noncarcinogenicity for humans.

TABLE 8

TUTU WELLS SITE
COMBINING CARCINOGENIC RISKS ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL CANCER RISK	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO RISK
SURFACE SOIL				
Tillett Gardens and Art Center Area	Residents: Adults	Ingestion	8.2E-06	Arsenic
		Dermal Contact	NA	--
		Inhalation of Particulates	5.5E-07	--
		Total Carcinogenic Risk =	8.8E-06	Arsenic
	Children (0-6 years)	Ingestion	1.9E-05	Arsenic
		Dermal Contact	NA	--
		Inhalation of Particulates	6.4E-07	--
		Total Carcinogenic Risk =	2.0E-05	Arsenic
Fire Dept./Texaco gas station/ Antilles auto parts/ Ramsay motor co. Area	Site Workers (Employees)	Ingestion	1.3E-06	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.7E-09	--
		Total Carcinogenic Risk =	1.3E-06	--
Curriculum Center Building Area (Present-Use)	Site Workers (Employees)	Ingestion	3.7E-06	--
		Dermal Contact	NA	--
		Total Carcinogenic Risk =	3.7E-06	--
Curriculum Center Building Area (Future-Use)	Site Workers (Employees)	Ingestion	9.1E-07	--
		Dermal Contact	NA	--
		Inhalation of Particulates	4.5E-08	--
		Total Carcinogenic Risk =	9.6E-07	--
O'Henry dry cleaners and Liquor Barn Area	Site Workers (Employees)	Ingestion	9.7E-06	--
		Dermal Contact	NA	--
		Inhalation of Particulates	3.4E-07	--
		Inhalation of VOCs	4.9E-07	--
		Total Carcinogenic Risk =	1.1E-05	--
Tillett Gardens and Art Center Area (Future-Use)	Construction Workers	Ingestion	5.7E-05	--
		Dermal Contact	4.3E-05	--
		Inhalation of Particulates	6.6E-09	--
		Total Carcinogenic Risk =	1.0E-04	--

TUTU WELLS SITE
COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL HAZARD INDEX	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO HAZARD INDEX VALUES
SURFACE SOIL				
Tillett Gardens and Art Center Area	Residents: Adults	*Ingestion*	3.2E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	6.7E-01	--
		Total Hazard Index =	9.9E-01	--
	Children (0-6 years)	Ingestion	3.0E+00	Manganese
		Dermal Contact	NA	--
		Inhalation of Particulates	3.1E+00	Manganese
		Total Hazard Index =	6.1E+00	Manganese
Fire Dept./ Texaco gas station/ Antilles auto parts/ Ramsay motor co. Area	Site Workers (Employees)	Ingestion	9.7E-02	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.0E-01	--
		Total Hazard Index =	3.0E-01	--
Curriculum Center Building Area (Present-Use)	Site Workers (Employees)	Ingestion	2.5E-01	--
		Dermal Contact	NA	--
		Total Hazard Index =	2.5E-01	--
Curriculum Center Building Area (Future-Use)	Site Workers (Employees)	Ingestion	2.3E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.1E-01	--
		Total Hazard Index =	4.4E-01	--
O'Henry dry cleaners and Liquor Barn Area	Site Workers (Employees)	Ingestion	1.5E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.1E-01	--
		Inhalation of VOCs	NA	
		Total Hazard Index =	3.6E-01	--
Tillett Gardens and Art Center Area (Future-Use)	Construction Workers	Ingestion	9.9E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.4E-02	--
		Total Hazard Index =	1.0E+00	--

Ecological Risk

TABLE . 10

SUMMARY OF HAZARD INDICES
TUTU WELLS SITE

CHEMICAL	HAZARD INDEX	
	Anole (lizard)	Red-Tailed Hawk
VOLATILE ORGANICS		
Benzene	1.24 E-05	2.42 E-06
2-Butanone	6.44 E-05	1.26 E-04
Ethylbenzene	3.96 E-03	7.72 E-04
Methylene Chloride	4.34 E-05	8.47 E-06
4-Methyl-2-pentanone	2.64 E-03	5.16 E-05
Tetrachloroethylene	8.04	1.57
Trichloroethylene	1.09 E-04	2.14 E-05
Toluene	1.49 E-03	2.91 E-04
Xylenes (Total)	1.66 E-02	3.26 E-03
SEMI-VOLATILE ORGANICS		
Acenaphthene	NE	NE
Benzo(b)fluoranthene	NE	NE
Benzoic Acid	4.13 E-03	8.08 E-05
Benzo(g,h.i)perylene	NE	NE
Benzo(a)pyrene	6.57 E-03	1.28 E-03
Bis(2-ethylhexyl)phthalate	1.06 E-03	2.08 E-04
Chrysene	NE	NE
Di-n-butylphthalate	1.93 E-02	3.76 E-03
2,4-Dimethylphenol	0.12	2.3 E-02
Fluoranthene	0.151	2.96 E-04
Fluorene	8.64 E-04	1.68 E-04

TABLE 10

SUMMARY OF HAZARD INDICES
TUTU WELLS SITE
CONTINUED

CHEMICAL	HAZARD INDEX	
	Anole (lizard)	Red-Tailed Hawk
SEMI-VOLATILES (Cont'd)		
2-Methylphenol	NE	NE
4-Methylphenol	NE	NE
Naphthalene	NE	NE
Phenol	36.34	0.6
Pyrene	6.83 E-03	1.33 E-03
PESTICIDES/PCB'S		
Endosulfan I	3.37 E-02	6.57 E-03
Aroclor-1242	2.86	0.115
INORGANICS AND CYANIDE		
Aluminum	NE	NE
Antimony	NE	NE
Arsenic	80.8	0.334
Barium	NE	NE
Cadmium	3.45 E-03	1.57 E-04
Chromium, trivalent (Cr^{+3})	9.2 E-03	1.45 E-03
Chromium, hexavalent (Cr^{+6})	1.69	0.133
Cobalt	NE	NE
Copper	NE	NE

TABLE .| C

SUMMARY OF HAZARD INDICES
TUTU WELLS SITE
CONTINUED

CHEMICAL	HAZARD INDEX	
	Anole (lizard)	Red-Tailed Hawk
INORGANICS AND CYANIDE (Cont'd)		
Iron	NE	NE
Lead	4.42	0.864
Manganese	1.24	0.242
Nickel	1.98	0.222
Sodium	NE	NE
Vanadium	NE	NE
Zinc	NE	NE
Cyanide	1.31 E-03	2.55 E-04

NE denotes "not evaluated" due to lack of toxicity data.

[1] The most conservative chromium hazard index (i.e., Cr +6) was used in the determination of these cumulative indices.

Table 11. Groundwater Chemical-Specific Remedial Action Levels Identified for the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameters	Groundwater RALs USEPA MCLs (mg/L)	MCLGs (mg/L)
Inorganics		
Aluminum	0.05 to 0.20 (1)	--
Antimony	0.006	0.006
Arsenic	0.05	--
Barium	2.0	2.0
Beryllium	0.004	0
Cadmium	0.005	0.005
Calcium	--	--
Chromium	0.1	0.1
Cobalt	--	--
Copper	TT	1.3
Iron	0.3 (1)	--
Lead	TT	0
Magnesium	--	--
Manganese	0.05	--
Mercury	0.002	0.002
Nickel	0.1	0.1
Potassium	--	--
Selenium	0.05	0.05
Silver	0.1	--
Sodium	--	--
Thallium	0.002	0.0005
Vanadium	--	--
Zinc	5.0	--
Cyanide	0.2	0.2
Nitrate (as N)	10.0	10.0
Chloride	250 (1)	--
pH (units)	6.5-8.5	--
Total dissolved solids	500 (1)	--
Volatile Organic Compounds		
Chloromethane	--	--
Bromomethane	--	--
Vinyl chloride	0.002	0
Chloroethane	--	--
Methylene chloride	0.005	--
Acetone	--	--

See last page for footnotes.

Table 11. Groundwater Chemical-Specific Remedial Action Levels Identified for the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameters	Groundwater RALs: USEPA MCLs (mg/L)	MCLGs (mg/L)
Volatile Organic Compounds (continued)		
Carbon disulfide	--	--
1,1-Dichloroethene	0.007	0.007
1,1-Dichloroethane	--	--
1,2-Dichloroethene(cis)	0.07	0.07
1,2-Dichloroethene(trans)	0.1	0.1
Chloroform	--	--
1,2-Dichloroethane	0.005	0
2-Butanone	--	--
1,1,1-Trichloroethane	0.2	0.2
Carbon tetrachloride	0.005	0
Vinyl acetate	--	--
Bromodichloromethane	--	--
1,1,2,2-Tetrachloroethane	--	--
1,2-Dichloropropane	--	--
trans-1,2-Dichloropropene	--	--
Trichloroethene	0.005	0
Dibromochloromethane	--	--
1,1,2-Trichloroethane	0.005	0.003
Benzene	0.005	0
cis-1,3-Dichloropropene	--	--
Bromoform	--	--
2-Hexanone	--	--
4-Methyl-2-pentanone	--	--
Tetrachloroethene	0.005	0
Toluene	--	1
Chlorobenzene	--	--
Ethylbenzene	0.7	0.7
Styrene	0.1	0.1
Total xylenes	10	10
Pesticides/PCBs		
alpha-BHC	--	--
beta-BHC	--	--
delta-BHC	--	--
gamma-BHC(Lindane)	--	--
Heptachlor	--	0
Aldrin	--	0

See last page for footnotes.

Table 11. Groundwater Chemical-Specific Remedial Action Levels Identified for the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameters	Groundwater RALs USEPA MCLs (mg/L)	MCLGs (mg/L)
Pesticides/PCBs, continued		
Heptachlor epoxide	--	--
Endosulfan I	--	--
Dieldrin	--	--
4,4'-DDE	--	--
Endrin	0.002	0.002
Endosulfan II	--	--
4,4'-DDD	--	--
Endosulfan sulfate	--	--
4,4'-DDT	--	--
Methoxychlor	0.04	0.04
Chlordane(alpha and/or gamma)	--	0
Toxaphene	0.003	0
Aroclor 1016	--	--
Aroclor 1221	--	--
Aroclor 1232	--	--
Aroclor 1242	--	--
Aroclor 1248	--	--
Aroclor 1254	--	--
Aroclor 1260	--	--
Endrin ketone	--	--
Semivolatile Organic Compounds		
Phenol(s)	--	--
bis(-2-Chloroethyl)ether	--	--
2-Chlorophenol	--	--
1,3-Dichlorobenzene	0.6	0.6
1,4-Dichlorobenzene	0.075	--
Benzyl alcohol	--	--
1,2-Dichlorobenzene	0.6	0.6
2-Methylphenol	--	--
bis(2-Chloroisopropyl)ether	--	--
4-Methylphenol	--	--
N-Nitroso-di-propylamine	--	--
Hexachloroethane	--	--
Nitrobenzene	--	--
Isophorone	--	--
2-Nitrophenol	--	--

See last page for footnotes.

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Table 11 Groundwater Chemical-Specific Remedial Action Levels Identified for the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameters	Groundwater RALs USEPA MCLs (mg/L)	MCLGs (mg/L)
Semivolatile Organic Compounds (continued)		
2,4-Dimethylphenol	--	--
Benzoic acid	--	--
bis(2-Chloroethoxy)methane	--	--
2,4-Dichlorophenol	--	--
1,2,4-Trichlorobenzene	0.07	0.07
Naphthalene	--	--
4-Chloroaniline	--	--
Hexachlorobutadiene	--	--
4-Chloro-3-methylphenol	--	--
2-Methylnaphthalene	--	--
Hexachlorocyclopentadiene	0.05	0.05
2,4,6-Trichlorophenol	--	--
2,4,5-Trichlorophenol	--	--
2-Chloronaphthalene	--	--
2-Nitroaniline	--	--
Dimethylphthalate	--	--
Acenaphthylene	--	--
3-Nitroaniline	--	--
Acenaphthene	--	--
2,4-Dinitrophenol	--	--
4-Nitrophenol	--	--
Dibenzofuran	--	--
2,4-Dinitrotoluene	--	--
2,6-Dinitrotoluene	--	--
Diethylphthalate	--	--
4-Chlorophenyl-phenylether	--	--
Fluorene	--	--
4-Nitroaniline	--	--
4,6-Dinitro-2-methylphenol	--	--
N-Nitrosodiphenylamine	--	--
4-Bromophenyl-phenylether	--	--
Hexachlorobenzene	0.001	0
Penta-chlorophenol	0.001	0
Phenanthrene	--	--
Anthracene	--	--
Di-n-butylphthalate	--	--
Fluoranthene	--	--

See last page for footnotes.

Table 11 Groundwater Chemical-Specific Remedial Action Levels Identified for the Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Parameters	Groundwater RALs USEPA MCLs (mg/L)	MCLGs (mg/L)
Semivolatile Organic Compounds (continued)		
Pyrene	--	--
Butylbenzylphthalate	0.1 (P)	0 (P)
3,3'-Dichlorobenzidine	--	--
Benzo(a)anthracene	0.0001 (P)	0 (P)
bis(2-Ethylhexyl)phthalate	0.006	0
Chrysene	--	--
Di-n-octyl phthalate	--	--
Benzo(b)fluoranthene	0.0002 (P)	0 (P)
Benzo(k)fluoranthene	--	--
Benzo(a)pyrene	0.0001	0
Indeno(1,2,3-c d)pyrene	0.0004 (P)	0 (P)
Dibenz(g,h)anthracene	0.0003 (P)	0 (P)
Benzo(g,h,i)perylene	--	--

All RALs expressed in milligrams per liter (mg/L) unless indicated.
Currently, there are no federal standards for soil or sediment.

mg/L	Milligrams per liter.
TT	Treatment Technique (Action Levels: Copper 1.3 mg/L, lead 0.015 mg/L). Values determined by USEPA.
(1)	Value classified as a Secondary Maximum Contaminant Level (SMCL).
USEPA	U.S. Environmental Protection Agency.
RALs	Remedial Action Levels.
MCLs	Maximum contaminant levels.
MCLGs	Maximum contaminant level goals.
PCBs	Polychlorinated biphenyls.
--	No standard available.
(P)	Proposed.

Table 12 Summary of Soil Screening Levels Provided by the U.S. Environmental Protection Agency, Tutu Wells Site, St. Thomas, U.S. Virgin Islands.

Property	Depth (ft bls)	Chlorinated VOCs (ppb)	BTEX Compounds (ppb)
Curriculum Center (former LAGA Facility)	0.0 - 2.8	731	150
	2.8 - 35.0	73	37
Texaco Tutu Service Station	0.0 - 8.7	290	67
	8.7 - 15.0	29	13
Esso Tutu Service Station	0.0 - 4.0	320	74
	4.0 - 15.0	32	15
O'Henry Dry Cleaners	0.0 - 1.6	375	--
	1.7 - 22.0	31	--
Other properties [1]	0.0 - 4.0	320	74
	4.0 - 15.0	32	15

Soil screening levels are based on site-specific estimates for leaching of contaminants that may result in exceedance of groundwater drinking standards (CDM Federal Programs Corporation 1995b).

ft bls Feet below land surface.
VOCs Volatile organic compounds.
BTEX Benzene, toluene, ethylbenzene, and xylenes.
ppb Parts per billion, equivalent to micrograms per kilogram (ug/kg).
-- No values provided.
(1) The U.S. Environmental Protection Agency (USEPA) directed the use of soil screening levels for the Esso Tutu Service Station at all other properties.

APPENDIX III

ADMINISTRATIVE RECORD INDEX

APPENDIX IV

TERRITORIAL LETTER OF CONCURRENCE

ENVIRONMENTAL PROTECTION
TDD (809) 777-8413

GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

DEPARTMENT OF PLANNING AND NATURAL RESOURCES
WHEATLEY SHOPPING CENTER II
CHARLOTTE AMALIE, ST. THOMAS, V.I. 00802

July 18, 1996

Ms. Jeane Fox
Regional Administrator
U.S. Environmental Protection Agency
290 Broadway
New York, NY 10007-1866

Dear Ms. Fox,

This letter provides the Virgin Islands Department of Planning and Natural Resources' (DPNR's) concurrence on the U.S. Environmental Protection Agency's (EPA's) Record of Decision for the Tutu Wellfield Site in St. Thomas.

DPNR expects to work closely with EPA during the implementation of the selected Soil Remediation Alternative (SRA 3/4) and Groundwater Remediation Alternative (GRA 4). DPNR considers this Record of Decision as an important step toward the eventual reclamation of a valuable Virgin Islands resource.

Thank you for your consideration in this matter.

Sincerely yours,

Beulah Dalmida-Smith

Beulah Dalmida-Smith
Commissioner

cc: Kathleen Callahan, EPA

APPENDIX V

RESPONSIVENESS SUMMARY
ATTACHMENT A

LETTERS SUBMITTED DURING THE PUBLIC COMMENT PERIOD

APPENDIX V

RESPONSIVENESS SUMMARY

TUTU WELLFIELD SUPERFUND SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

A. INTRODUCTION

A responsiveness summary is required by Superfund policy. It provides a summary of citizens' comments and concerns received during the public comment period, and the United States Environmental Protection Agency's (EPA's) and the Virgin Islands Department of Planning and Natural Resources's (DPNR's) responses to those comments and concerns. All comments summarized in this document have been considered in EPA's and DPNR's final selection of a remedial action for the Tutu Wellfield site.

B. OVERVIEW

At the time of the public comment period, EPA had already identified a preferred remedial alternative for the Tutu Wellfield Superfund Site in St. Thomas, U.S. Virgin Islands. EPA's recommended alternative addressed the soil and groundwater contamination problems at the site. The selected alternative specified in the record of decision (ROD) for soils involves a combination of institutional controls, in-situ (in place) or ex-situ soil vapor extraction (SVE), excavation, and on-site or off-site disposal. The selected alternative for groundwater involves institutional controls, source and plume containment, treatment using an air stripper, and discharge of treated water.

Judging from the comments received during the public comment period, local residents and other concerned parties, including the League of Women Voters of the Virgin Islands (LWVVI), the public generally supports the Proposed Plan that outlined the preferred alternative and agrees that a combination of soil remediation alternatives 3 and 4 and groundwater remediation Alternative 4 provide the greatest means for protection of human health and the environment.

These sections follow:

- Background on Community Involvement
- Summary of Comments Received During the Public Comment Period and Agency Responses
  - Part I: Summary and Response to Local Community Concerns
  - Part II: Comprehensive Response to Specific Legal and Technical Questions

- Remaining Concerns
- Attachment: Community Relations Activities at the Tutu Wellfield Superfund Site

C. BACKGROUND ON COMMUNITY INVOLVEMENT

Community interest in the Tutu Wellfield Superfund Site dates to July 1987 when Mr. Eric Tillett noticed an odor emanating from his well. He contacted DPNR, and DPNR in turn contacted EPA for assistance. Since 1987, community concern and involvement have remained fairly active.

Major concerns expressed during the remedial planning activities at the Tutu site focused on the notification of potentially responsible parties (PRPs), the interpretation of sampling results and continued use of well water, the extent of contamination and cleanup schedule, and the restoration of the environment. These concerns and how EPA addressed them are described below:

(1) Some PRPs expressed concern about their future liability and requested that EPA consider relief such as de minimis settlements.

EPA Response: EPA has not identified a "de minimis" PRP at the Site, for purposes of Section 122(g) of CERCLA, 42 U.S.C. §9622(g). EPA has had a number of meetings with some or all of the PRPs where liability issues have been discussed, and the PRPs will have an additional opportunity to discuss issues relating to the status of the parties when remedial design/remedial action ("RD/RA") negotiations are conducted with EPA immediately following insurance of the ROD.

(2) Residents requested that EPA present sampling results in a meaningful way and assure only authorized water use by public establishments and private citizens.

EPA Response: In February 1995, EPA mailed letters to residential well owners that expressed sampling results in terms of the level of contaminants in their wells versus acceptable, federal drinking water standards and provided information on health risks. Concerning water use, EPA has continued to restate the distinction between its role to make recommendations based on risk studies and DPNR's role to regulate water use in the local area.

(3) The community is concerned about whether or not the plumes are moving or have become larger, and would like to know when cleanup activities will begin.

EPA Response: EPA is monitoring the areas of contamination periodically and is prepared to take immediate action should any movement of the plumes pose an imminent threat to human health or the environment. Once the ROD is signed, EPA will enter into RD/RA negotiations with the PRPs, about a 2 to 4-month process, and, subsequently, the remedial design phase will be commenced.

(4) The community would like the affected aquifer restored to acceptable federal drinking water standards so that all Islanders can enjoy its use.

EPA Response: It is the goal of EPA to implement a cleanup technology that will contain the sources of contamination and associated plumes, remove the contaminants from groundwater by extraction and treatment, and, where technically feasible, restore the aquifer water quality to be suitable for public consumption.

The RI report, FS report and the Proposed Plan for the site were released to the public for comment on August 23, 1995. These documents were made available to the public in the administrative record file at the EPA Docket Room in Region II, New York and the information repositories at the Curriculum Center in Anna's Retreat and the DPNR offices in the Wheatley Shopping Center. A public meeting to present the Proposed Plan was scheduled for September, 1995. However, due to Hurricane Marilyn's destruction to St. Thomas in September, the public meeting was canceled until basic living and working conditions could be restored to the Island. The Proposed Plan was reissued on February 12, 1996. The public comment period on these documents was held from February 12 to March 13, 1996.

On March 5, 1996, EPA conducted a public meeting at the Curriculum Center in Anna's Retreat to inform local officials and interested citizens about the Superfund process, to review current and planned remedial activities at the site, and to respond to any questions from area residents and other attendees.

D. SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND AGENCY RESPONSES

The following correspondence (see Attachment A) was received during the public comment period:

- Letter from the League of Women Voters
- Letter from Dr. Henry Smith, Director of Water Resources Research Institute, University of the Virgin Islands
- Letter from the attorney representing Texaco
- Two letters from the attorneys and technical consultant for Western Auto
- Letter from the attorney representing O'Henry

A summary of the comments contained in the above letters and the comments provided by the public at the March 5, 1996, public meeting, as well as EPA's response to those comments follows. Part I of this section addresses those community concerns and comments that are non-technical in nature. Responses to specific legal and technical questions are provided in Part II. Comments in each Part are categorized by relevant topics.

Part I - Summary and Response to Local Community Concerns

Public Participation

(1) Concern was raised by an individual regarding meeting the community acceptance criterion and that EPA has not conducted enough community relations activities to meet this criterion. This individual stressed that it is important for the general public, particularly the affected community, to understand the documents presented to them by EPA, such as the Proposed Plan.

EPA Response: EPA responded that perhaps this individual was not aware of the extensive community interaction that has been conducted at this site and the efforts that were made to present technical and non-technical material in language that is understandable to the general public. At the Tutu Wellfield site this has been a continual process beginning in 1992 and continuing to the present. EPA has used a variety of outreach techniques to disseminate information about the site, its history, contamination and plans for cleanup to the affected community including interviews, fact sheets, and public meetings. EPA conducted face-to-face interviews with residents in the community in February 1992 and again in October 1994. Residents were given the opportunity to express their concerns, ask questions or request additional information. EPA has prepared three fact sheets which explained in nontechnical language the history of the site, the purpose of the studies and their results and answers to concerns raised during the interviews. These fact sheets were distributed to over 1400 residents of the Tutu Community. EPA also held several public meetings beginning with the release of the RI work plan, to offer the community opportunities to learn more about the Superfund process, to ask questions about those aspects they do not understand and to present comments and concerns during the public comment periods. The informal availability session held in April 1995 was attended by over 50 members of the affected community. Questions regarding groundwater and contaminant movement through the subsurface, cleanup technologies proposed by EPA and soil contamination found at the site were discussed in language understandable to the public. In addition, EPA has also enlisted volunteers in the community to pass along information to their neighbors in the form of printed handouts. Education on the Superfund process and the technologies related to the Tutu site has been ongoing as evidence of long-term commitment to public participation.

(2) Elaborate on other resources available to the community to better understand the situation at the Tutu site, beyond selection of the preferred alternative.

EPA Response: An organized group affected by a Superfund site can apply for a technical assistance grant (or TAG) in the amount of $50,000 to hire a technical consultant. This adviser would keep the group informed of ongoing site activities and help them better understand the entire process. EPA informed the public at the May 1992 and April 1995 meetings about the TAG process. Applications were available during these meetings also. Additional applications for a TAG are still available from EPA, upon request.

Extent of Contamination

(1) The community would like a general quantification of the amount of contamination found at the Tutu site.

EPA Response: EPA has placed monitoring wells throughout the Tutu site to quantify the amount of contamination at each property. At the LAGA building, for instance, the highest concentration of contamination was found to be 360 parts per billion (ppb) of perchloroethylene (PCE). The drinking water standard for PCE is 5 ppb. In addition, EPA is monitoring the size of the plumes surrounding these highly concentrated areas. The LAGA plume is estimated to be about 500 to 1,000 feet in length. (see Figure 4 of the ROD for graphical depiction and Table 2 for concentrations of contaminants detected)

Risks to Human Health and the Environment

(1) The community would like to know what they can do on a daily basis to reduce the risk of harm to their health from exposure.

EPA Response: Because the primary risk to human health is from groundwater, the community should not drink water from the aquifer. To ensure public safety, DPNR closed contaminated wells and affected residents are being supplied with trucked water for their potable use. With these precautions taken into consideration, the risk of accidental ingestion of contaminated groundwater is very small. In addition, the community is reminded that cancer risk estimates are based on long-term exposure, that is, the daily ingestion of more than two quarts of contaminated water for 30 years.

(2) Individuals are concerned about whether EPA or Health and Human Services plans to monitor a sample population over time to determine any health risks from the site contamination.

EPA Response: EPA itself does not conduct epidemiologic studies to follow a population in time to detect disease incidences. The Agency for Toxic Substances and Disease Registry (ATSDR) does have that capacity.

ATSDR Response: ASTDR will not be able to conduct an epidemiology study for this site because the population potentially affected is too small to derive meaningful results. Very large populations are necessary for such studies. However, ASTDR will conduct an education program for local health care professionals to teach them how to identify symptoms of exposure.

(3) The LWVVI is concerned about control of the plume, particularly threats to wildlife in the Mangrove Lagoon.

EPA Response: At present, contaminated groundwater from the Site has migrated to Delegarde well area. Measured concentrations in the Delegarde well are relatively low, about 30 ppb of total VOCs. Until the preferred remedy is implemented, contaminated groundwater from the Site will continue to migrate and will potentially discharge into a small wetland area and Turpentine Run immediately south of Delegarde on Rt. 32. From there, the discharged and diluted water will flow with the Turpentine Run stream towards Mangrove Lagoon, approximately 2 miles to the southeast. EPA's ecological risk assessment has determined that the Mangrove Lagoon has not been impacted from the Tutu Wells Site.

Implementation of the preferred remedy would place wells near the end of the plume to prevent discharge to the wetland described above, which is about 5 miles from the lagoon. During the remedial design phase, additional field studies will be conducted to assess and minimize any impacts that the selected remedy would have on the wetlands.

(4) The community would like to know if construction activities in the Tutu area could affect the dynamics of the aquifer and further endanger the environment.

EPA Response: We do not anticipate any significant impacts to the environment during construction activities at the Site. Any impacts would be minimized and controlled. Construction and implementation of the selected remedy would change the plume configuration by capturing the contaminants in the groundwater and preventing further migration of the contaminated groundwater. This would prevent further ecological or environmental impacts associated with the contaminated groundwater.

(5) Citizens were concerned about what techniques were used to clean their cisterns during the Superfund removal action in 1988 and whether EPA recommended any type of filtration system for residuals.

EPA Response: The cisterns were cleaned and disinfected using a high pressure water jet to physically flush contaminants from the system. For biological contamination, chlorine bleach (sodium hypochlorite solution) followed by a thorough rinse was conducted. At the same time, the plumbing of affected residential homes was modified to disconnect the cisterns from the well for regular home use. EPA did not recommend a filtration system because residents were being supplied with clean trucked water for potable use.

Cleanup Schedule

(1) Citizens want to know when the actual cleanup process will begin and whether the budget crisis will affect the schedule.

EPA Response: EPA anticipates that the ROD will be signed in the Summer of 1996. EPA then will ask the PRPs, the people who caused the pollution, whether they are willing to implement the remedy that EPA selected in the ROD. Assuming the PRPs agree to implement the cleanup, the process by which the PRPs negotiate and enter into a legal agreement to accept this responsibility takes appropriately two to four months. Next, the PRPs would have to conduct some pre-design field work and design the remedy, which can take up to two years. Actual cleanup would therefore take place about two and a half to three years from now. We do not presently expect EPA's budgetary limitations to significantly affect this Site since we expect that the PRPs will implement the remedy. However, cuts in the EPA's budget could affect our ability to oversee the project.

Cleanup Technology

(1) A community member asked how long wells will remain capped and what will be done with soil that is removed from the site.

EPA Response: The selected remedy calls for existing domestic and commercial wells within the confines of the groundwater plume to be decommissioned if these wells are determined to interfere with the operation of the groundwater pump and treat system that will be installed as part of this remedial action. During the remedial design it will be determined which wells would interfere with this remedial action and which wells would continue to operate as they may enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater. The amount of time that will take is unclear.

If soil to be removed from the Site is found to be hazardous, then it will be disposed of at a qualified treatment or disposal facility in compliance with EPA regulations. The facility will be located off-island, since the U.S.V.I. does not have a qualified facility that is permitted to accept hazardous wastes. If however, the soil that is excavated is found to be non-hazardous, it could be disposed of at a non-hazardous waste landfill on St. Thomas.

(2) A community member asked EPA to explain thermal oxidation.

EPA Response: Thermal oxidation is the process by which contaminated gases that are drawn from the ground are burned off in a properly controlled manner before being released to the environment at acceptable levels.

(3) Citizens would like to know what type of technology EPA will use to clean up the water and whether the water will be tested afterwards.

EPA Response: In addition to using pumping wells to control the plume, EPA or the PRPs will install a water treatment process. An air stripper is the most proven technology for volatile organic compounds, which are present at the site. EPA will test both the water influent, before it goes to the air stripper, and the effluent to make sure it meets federal drinking water standards before distribution or surface water criteria if the water is discharged to a storm drain.

(4) An interested party questioned whether there are any historical precedents where the cleanup alternatives EPA has proposed for the Tutu site have been proven to treat groundwater sufficiently for release to a public distribution system.

EPA Response: There are many instances where air strippers have been used to restore groundwater to federal and state drinking water standards for further consumption by the public. This technology is particularly common in Long Island, New York which is a designated sole source aquifer.

Restoration of the Aquifer and Protection of the Environment

(1) The community would like to know how long it will take to restore the aquifer.

EPA Response: Two properties (the Curriculum Center and the O'Henry properties) within the Tutu site may have DNAPLs (dense non-aqueous phase liquids) in the groundwater and subsurface soils, which if present, will act as a continuous releasing source to the fractured rock in these locations. If DNAPLs are present, EPA or the PRPs will have to continuously pump and control the movement of this plume. While the fringes of the plume could possibly be cleaned up quickly, perhaps in three to five years, restoration of the aquifer in the source areas could take considerably longer, tens of years, and may not be technically able to be restored in the foreseeable future.

(2) EPA has stated that it will restore the groundwater to potability, except where DNAPLs are present. The LWVVI would like to know how EPA has determined with certainty the location of DNAPLs at the Tutu site.

EPA Response: EPA determined the location of probable DNAPLs at two properties at the Tutu site using an indirect process. The concentration of contaminants in the groundwater at these two locations is significantly higher than what would result from the soil concentration at these locations. This finding suggests that pure product may be locally present in the subsurface soils and leaking into groundwater.

(3) The community would like to know whether monitoring programs are in place to protect the Island's resources from the threat of further contamination related to the various properties located at the Tutu site, as well as other properties throughout the Islands that operate similar businesses, such as gas stations and dry cleaners.

EPA Response: Both EPA and DPNR are involved in monitoring programs at the Tutu site to assure that no further contamination occurs as a result of these facilities. In addition, there are Island-wide monitoring programs to protect the environment. One Federal Law (the Resource, Conservation and Recovery Act (RCRA) and implementing regulations) regulates the installation, operation, and maintenance of underground storage tanks used by petroleum companies and the proper handling and disposal of perchloroethylene ("perc"), the primary waste product generated by dry cleaners.

Part II - Comprehensive Response to Specific Legal and Technical Questions

Wording of Proposed Plan

(1) Texaco presented a list of suggested revised wording for the Proposed Plan.

EPA Response: The Proposed Plan will not be reissued. However, EPA has considered Texaco's proposed revisions to the text in context of the Record of Decision. Texaco proposed that the SVE systems should be operated until VOCs are present in the extraction well air vapor stream at "acceptable levels." EPA does not agree with this proposal and instead has provided in the ROD that the SVE systems will be operated until no VOCs are present in the extraction well air vapor systems.

Proposed Remedy for Western Auto

(1) Western Auto protested the proposed soil remedy of excavation for their former facility, based on the following arguments:

a) The soil screening levels (SSLs) developed for Esso are not applicable to the Western Auto site because the geology at their site is different than that at Esso;

b) The SSLs were determined based on benzene and are overly conservative for other BTEX compounds;

c) Western Auto already excavated the contaminated soil when they removed their underground storage tank in 1994;

d) Western Auto recently built a concrete cap over the entire area of concern, excluding only the area where the 4-inch PVC pipe was excavated, to prevent migration of any remaining contaminants in soil; and

e) If there are any contaminants remaining in soil they will not move to groundwater because 1) the concrete cap prevents infiltration of rain water, and 2) there is a very low permeability clay (test results provided) underlying the gravels at the site that will prevent migration to groundwater.

EPA Response: EPA has considered the comments and evidence submitted by Western Auto.

a) Because vadose zone modeling is a time-consuming process, soil profiles and soil screening levels (SSLs) were only developed for the four properties suspected of being the major contributors of groundwater contamination. These SSLs were then applied to the other properties as a screening level exercise. The geology at Western Auto is more similar to that at Esso than to the geology at O'Henry, Texaco, or the Curriculum Center, so Esso's SSLs were applied to Western Auto. It should be noted that the SSLs for O'Henry, Esso and Texaco are virtually identical.

b) The SSLs are intentionally very conservative cleanup goals and are geared towards the highest risk, most mobile contaminants, on the theory that if the soil is remediated to address the compound with the most stringent SSLs, then the other compounds in that chemical group will simultaneously be addressed. EPA acknowledges that if benzene is not present in soils at Western Auto, then higher SSLs could be used and still be protective of groundwater. The new SSLs would have to be determined based on the chemical characteristics and transport properties of toluene, ethylbenzene or xylenes.

c) EPA, at this time, is not prepared to refute the allegation that the majority of soil contamination at Western Auto was excavated during the UST removal. However, the removal was performed without EPA oversight. EPA is concerned that soil contamination remains, because inadequate confirmatory sampling was performed at the time to assure either DPNR or EPA that all residual contamination had been excavated.

d) The concrete cap had not been installed when EPA identified the preferred remedy for the Proposed Plan.

e) EPA agrees that the presence of the underlying clay, combined with the overlying concrete will reduce the risk of migration of any residual soil contaminants to groundwater. However, additional excavation may need to be performed unless a confirmatory sampling program around the tank grave indicates that residual contaminated soils still present are not above EPA's SSLs. Additional confirmatory soil sampling will be performed during remedial design. If the confirmatory soil sampling reveals contaminant concentrations above the SSLs, additional excavation will be performed. The concrete cap must be routinely inspected and maintained free of cracks.

PVC Pipe beneath Four Winds

(1) Western Auto reiterated that the 4-inch PVC pipe that was ruptured during their tank excavation originates beneath the Four Winds Plaza and should be addressed by Four Winds, not Western Auto. Western Auto excavated the pipe on their former property up to the edge of the building, where they cut and capped it. Western Auto believes that this pipe is probably the source of the petroleum compounds (diesel and heavier hydrocarbon constituents) identified beneath Four Winds Plaza by a Gore Sorber soil gas survey.

EPA Response: EPA agrees that the pipe is the probable source of the hydrocarbons detected in soil gas beneath the Four Winds Plaza. These contaminants do not appear to have impacted groundwater yet. However, EPA will be requiring Four Winds to investigate the pipe for leaks using inline survey techniques and to repair any significant ruptures identified during remediation. Groundwater downgradient of Four Winds will be monitored during the implementation of the Tutu aquifer remedy to make sure that Four Winds is not acting as a source of groundwater contamination.

Esso as a Source of Chlorinated VOCs to Soil and Groundwater

(1) Both Western Auto and O'Henry commented that Esso should be identified as a source of VOC releases to soil and groundwater. They believe that the full extent of VOC contamination in soils at Esso has not been adequately delineated in the RI or Esso's plan for source control investigations (prepared by Forensic Environmental Services). Western Auto presented a graphic profile of VOC concentrations in groundwater showing probable impacts to groundwater in the vicinity of the Esso service station.

EPA Response: Esso has been identified in the RI as a source of VOC releases to soils and a probable source of VOCs to groundwater. The full extent of VOC soil contamination is not known at this time. Esso's source control action will be an integral part of the final remedy for the Tutu site. As part of their pre-design investigations, Esso will install additional borings to confirm the extent of VOC contamination of soils. Soil vapor extraction wells are planned to remove the VOCs, as well as the BTEX, in soils. The exact location of these wells will not be decided until the additional pre-design investigations are complete.

With respect to Esso's contribution of VOC's to groundwater, EPA agrees that monitoring well data indicate a probable impact in the vicinity of the service station.

(2) O'Henry states that since the gasoline additive, MTBE, can be traced from Texaco and Esso as far downgradient as the Delegarde well, that Esso must be considered a source of impact to groundwater all the way to the Delegarde well. Furthermore, O'Henry contends that the groundwater flow maps in the RI misrepresent flow in the vicinity of O'Henry. O'Henry's consultant, IT, has recontoured the VOC maps from the RI to show their interpretation that groundwater from O'Henry is separated from the southern VOC plume by a groundwater divide, whereas Esso is upgradient of the VOC plume and, by implication, the principal source of it.

EPA Response: Although the distribution of the gasoline additive MTBE in site groundwater strongly suggests that some constituents in groundwater originating at Esso have traveled past O'Henry to the leading edge of the plume, it is unclear that either BTEX or VOCs from Esso have traveled that far. VOCs do not travel as quickly as MTBE and therefore, will not migrate as far in a given amount of time. Concentrations of total VOCs in groundwater downgradient of Esso, but upgradient of O'Henry, range from non-detect to 19 ug/l. Downgradient of O'Henry, concentrations increase to greater than 100 ug/l. The Eglin wells, which are located between the two facilities had total VOC concentrations up to 74 ug/l, but they have been pumping and could draw water from O'Henry as well as from Esso.

The effects of historical and current well pumping complicate the interpretation. The historical pumping of the Harvey well near O'Henry and the current pumping of the Eglin wells has probably significantly affected the migration of VOC contamination from Esso and O'Henry. Based on the available groundwater quality and flow data, it is unclear at this point in time whether Esso VOCs are commingled with the VOC plume from O'Henry. Additional groundwater sampling of Esso's and other monitoring wells during the pre-design stage, combined with groundwater modeling to be performed during the extraction system design stage, should assist in the determination of the extent of VOC migration from the Esso station.

The depictions of groundwater flow direction and contaminant distribution presented in the RI are reasonable, honor all available data, and fit the regional flow field. There is a degree of interpretation to the flow direction, due to the spacing of the wells, but this is not sufficient to change the overall conclusions. O'Henry's interpretation of groundwater flow relies upon the inference of a groundwater divide to separate groundwater flow emanating from O'Henry from that of Esso. However, this groundwater "high" transects the topographic ridge east of O'Henry and was observed in only one round of deep well data. It is not apparent in either sampling round in the shallow groundwater data, which is where a topographic influence on groundwater flow might be expected. The O'Henry interpretation of flow and contaminant distribution does not take into consideration the effect of pumping the Eglin wells.

(3) O'Henry states that a flow path between the Harvey well and the Smith or La Place wells is impossible, considering their interpreted flow paths. Therefore the VOCs detected in these wells must come from Esso, not O'Henry.

EPA Response:

Based on groundwater flow maps presented in the RI, the Smith and LaPlace wells do appear to be located cross-gradient from the O'Henry plume. However, the flow fields presented in the RI do not consider the effects of pumping from the Eglin wells, which would partially draw O'Henry VOCs towards the east. Also, impacts on flow fields from pumping at the Smith and LaPlace wells need to be considered. The Tutu aquifer is a complex fracture flow system, where flow will preferentially follow high conductivity zones. O'Henry cannot be ruled out as a contributor of contamination in these residential wells based on a literal interpretation of the RI flow maps.

Groundwater Flow in the Vicinity of Esso

(1) Western Auto's consultant, ENSR, commented on the lack of supporting data for a perched water table and the calculated groundwater velocity at Esso presented in Esso's plan for source control investigations, prepared by Forensic Environmental Services.

EPA Response:

One of the purposes of the source control investigations is to collect additional data to refine the current interpretation of groundwater flow at the Esso station to improve the source control design. The estimates presented in the work plan will be modified as new site data become available.

Current Location of Groundwater Contaminant Plumes

(1) O'Henry commented that most of the groundwater elevation data in the RI was collected during a drought. Since Hurricane Marilyn, rainfall has increased dramatically and it is possible that the location of the groundwater contamination plumes have shifted.

EPA Response:

Additional water level and contaminant concentration data will need to be collected during the design stage. This information will be used in conjunction with groundwater flow and transport modeling to ensure adequate placement of extraction wells to capture the contamination in the Tutu aquifer.

Presence of DNAPLs at O'Henry

(1) O'Henry comments that the actual evidence obtained during the remediation of the soil at the O'Henry Dry Cleaning Store demonstrates that DNAPL contamination is not present in the soil.

EPA Response: The possible presence of DNAPLs beneath the O'Henry building or in fractures above or below the water table cannot be ruled out, even with the recent excavation data. DNAPLs can be very difficult to locate in the subsurface. Their probable presence is indicated by the very elevated concentrations of PCE (at greater than 1% of its solubility) detected in the Harvey well in the past and are supported by the historical site usage/disposal of PCE filters. Concentrations of PCE in the Harvey well are now an order of magnitude lower than in the past. However, the groundwater flow field has changed in the past few years. Under its current non-pumping conditions, the Harvey well could now be cross gradient, rather than downgradient of a potential source of DNAPLs. DNAPL is very persistent in the environment. If DNAPLs were present in 1991 when the Harvey well concentrations were high, they are likely to be present still.

If DNAPL is present, it may very well significantly affect the duration of the remedy and the potential for complete aquifer restoration in the vicinity. If it is present, a technical impracticability waiver for ARARs achievement may ultimately be required, because such groundwater cleanup objectives might not be achievable.

Proposed Soil Remedy for O'Henry

(1) O'Henry protested the proposed remedy of excavation and soil vapor extraction, stating that remediation has already occurred at O'Henry when they excavated soils behind the facility in 1995 with EPA approval and oversight. Further, it is O'Henry's opinion that the cleanup standards provided by EPA have been incorrectly calculated because they do not take into account all site-specific data.

EPA Response: The soils at O'Henry were excavated before EPA had finalized their vadose zone modeling to determine soil cleanup levels that would be protective of groundwater. O'Henry was aware at the time of the provisional nature of the cleanup goal they were using to define the excavation limits. Regardless, concentrations of PCE detected in the excavation walls are high enough to result in groundwater concentrations above MCLs, whether IT's VLEACH model or EPA's soil leaching model are used. EPA re-ran its soil leaching model, incorporating the newly available site-specific data from O'Henry and using a soil contaminant profile of the current, post-excavation concentrations of PCE. The resulting groundwater concentrations are still above drinking water standards, therefore EPA considers that soils at O'Henry still require remediation.

EPA's selected remedy does not call for any further excavation at O'Henry unless in-situ SVE does not work. However, soil vapor extraction must be attempted to reduce the remaining VOC concentrations in soil.

Technical Feasibility of Remediating the Tutu Aquifer

(1) O'Henry commented that there is no basis in the administrative record to assume that cleanup to groundwater standards through the decommissioning of existing wells and installation of groundwater recovery wells will be cost effective or will result in restoration of the groundwater to drinking water standards.

EPA Response: EPA acknowledges that it may not be possible to restore the entire aquifer to drinking water standards, especially if DNAPLs are present. However, if such sources are locally present and are controlled to contain their spread, then it should at least be technically feasible to restore the remainder of the aquifer to a potable water supply within a reasonable time frame.

E. REMAINING CONCERNS

Issues and concerns that EPA was unable to address during remedial planning activities include the following:

- **Will EPA intensify its sampling program once groundwater from the affected wells is considered safe for human consumption?**

  As part of the operation and maintenance plan to be implemented after construction of the remedy is complete, long-term semi-annual sampling of approximately 15 wells at or near the plumes will be conducted. During that time, EPA will re-evaluate its sampling program to determine if more frequent or less frequent testing is warranted.

- **The LWVVI is concerned that, during the March 5, 1996 public meeting, ATSDR stated that the population affected by the Tutu well pollution is too small to merit an epidemiological study, although ATSDR will conduct an education program for local health care professionals. The LWVVI would like the dissemination of information to extend to non-professionals in the community and has offered to help with publicity and follow-up activities through the local media.**

EPA welcomes any efforts that the LWVVI is willing to make in concert with the ATSDR to reach the general community with information about health risks associated with the site. Involvement of the LWVVI in news articles and radio and television programs would be helpful. LWVVI's letter of offer of assistance was forwarded to Steve Jones, ATSDR Regional Representative. He is located at 290 Broadway, 18th Floor, New York, NY 10007-1866.

ATTACHMENT A

COMMUNITY RELATIONS ACTIVITIES AT THE TUTU WELLFIELD SUPERFUND SITE

Community relations activities conducted at the Tutu Wellfield Superfund Site have included:

- EPA conducted community interviews with local residents and property owners, personnel from the VI Department of Health and DPNR, and a member of the VI legislature (February 1992)

- EPA prepared Community Relations Plan (April 1992)

- EPA established information repositories at the Tutu Hi Rise building and the DPNR office at the Nisky Shopping Center (April 1992), since moved to the Wheatley Shopping Center II following Hurricane Marilyn.

- EPA prepared and distributed a fact sheet that describes the Superfund program and reviewed the history of the Tutu Wellfield site, and opportunities for community involvement (April 1992,

- EPA issued a notice in the paper advertising a public meeting to discuss the work plan for the remedial investigation (May 1992)

- EPA held its first public meeting to discuss the work plan for the remedial investigation/feasibility study (RI/FS), present an overview of the Superfund process, and discuss risk assessment investigations (May 1992)

- EPA prepared and distributed a fact sheet outlining the schedule and work tasks of the remedial investigation (May 1992)

- ATSDR conducted an assessment of public health concerns and held two public meetings in the community, but there was no attendance (December 1992)

- EPA conducted a second set of interviews in the Tutu community to gain a firsthand perspective on the effectiveness of its community relations activities thus far (October 1994)

- EPA relocated the information repository from the Tutu Hi Rise Housing Authority to the Department of Education Curriculum Center, per several requests from the public (October 1994)

- EPA mailed letters to residential well owners in Tutu, explaining their well sampling results (February 1995)

- EPA prepared and distributed a fact sheet to over 1400 members of the affected community addressing concerns citizens have raised during the October - November 1994 interviews. The fact sheet was prepared in a question and answer format. The fact sheet also contained information explaining presumptive remedy and soil vapor extraction (March 1995)

- EPA prepared Revised Community Relations Plan (March 1995)

- EPA prepared and distributed flyers announcing an informal availability session held at Curriculum Center in Anna's Retreat (April 1995)

- EPA held an informal availability session at the Curriculum Center in Anna's Retreat. Technical specialists were present with maps and figures to answer questions on groundwater and soil contamination, contaminate movement through subsurface, and cleanup technologies (April 1995)

- EPA publicized a public comment period to be held from February 12, 1996 to March 13, 1996 by advertising in the local newspapers, on the radio, distributing flyers and displaying posters (February 1996)

- EPA held a public meeting at the Curriculum Center in St. Thomas to record comments by the public on results of the RI/FS and the proposed plan (March 1996). A transcript of this hearing is available at the information repositories located at the Curriculum Center and DPNR.

TWO THOUSAND WESTCHESTER AVENUE
WHITE PLAINS, N. Y. 10650

March 12, 1996

Caroline Kwan
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866

**RE: Tutu Wellfield NPL Site
Revised Superfund Proposed Plan**

Dear Ms. Kwan:

These brief comments regarding the above-referenced draft document are submitted on behalf of Texaco Caribbean Inc. (TCI). TCI has been identified by the Environmental Protection Agency (EPA) as a potentially responsible party (PRP) at the Tutu Wellfield site.

1. It is unclear from the legend and map in Figure 1 which portions of the plumes indicated represent Chlorinated VOCs >100 ppb.

2. On page 8, right column, we believe that following should be added to the soil objectives in the section titled "Remedial Action Objectives"

Removal of contaminants of concern in-situ, where practicable.

3. On page 9, left column, we believe that the following language should be added after the first paragraph in the section titled Soil Remedial Alternatives (SRA) for Impacted Soil":

These SCPs can be implemented as early as Spring 1996.

As we have discussed, Texaco has designed and is prepared to implement a remedial system to fulfill the SCP objectives articulated in the Proposed Plan.

4. On page 9, right column, we believe that the language in the third bullet in SRA 1 overstates the objective and should be reworded to say that soil or rock from impacted areas should not be removed unless it is appropriately tested and then, if indicated, properly treated or disposed of.

5. On page 10, right column, we believe that the language in the first full paragraph after the bullets related to SRA 3 should be

modified to state that: "The SVE systems described would be operational until VOCs are present in the extraction well air vapor stream at acceptable levels."

6. On page 12, left column, we believe that the following language should be added after the first paragraph in the section titled Groundwater Remedial Alternatives (GRA) for Impacted Groundwater":

These SCPs can be implemented as early as Spring 1996.

Again, as we have discussed, Texaco has designed and is prepared to implement a remedial system to fulfill the SCP objectives articulated in the Proposed Plan.

7. Regarding GRAs 2-4, we believe that EPA has previously indicated that connection to the WAPA system is a possible component of the alternatives. If this is the case, it should be indicated in the title and text of the alternative descriptions.

Thank you for this opportunity to comment on the Proposed Plan document. Feel free to contact me at 914-253-4633 to discuss these comments.

Sincerely,

Timothy R. Knutson
Counsel for Texaco Caribbean Inc.

ENSR

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March 13, 1996

ENSR Ref. No: 7218-001
ENSR Doc. No: 55-DPG-552

Ms. Caroline Kwan
Emergency and Remedial Response Division
U.S. Environmental Protection Agency
26 Federal Plaza
New York, NY 10278

RE: Comments on Draft Final FS
Tutu Wells Site, St. Thomas, U.S. Virgin Islands

Dear Ms. Kwan:

At the request of Western Auto's attorneys, this letter provides comments on the Draft Final Feasibility Study (FS).

- **The use of Esso Tutu SSL values at Western Auto is inconsistent with the available geologic information.**

On page 2-15, paragraph 1 it is stated that the SSL values developed for Tutu Esso are used for all properties in the Tutu Site region, except those where site specific SSLs were developed, because "...the subsurface conditions at the Esso Tutu Service Station are representative of conditions throughout the Tutu Valley". This means that the SSL values developed for Esso Tutu have been used for the former underground storage tank (UST) area behind Western Auto. However, the geologic conditions behind Western Auto are not similar to those at Esso Tutu, or elsewhere in Tutu Valley. This is, in fact, stated in the FS on page 2-5 (paragraph 1, last sentence) as follows... " An exception to this condition was observed at Western Auto, where alluvial deposits were only saturated in a perched zone within a gravel layer overlying a clay layer".

The hydraulic conductivity of the clay at Western Auto is extremely low with measurements values of 1.2×10^{-9} and 4.3×10^{-9} (see enclosed Stephens and Associates report). The very low hydraulic conductivity and the continuous extent of this clay layer creates a condition unlike that elsewhere in Tutu Valley. These geologic conditions effectively isolate the overlying alluvial material from the groundwater. Since the intent of the SSL values is apparently to provide soil cleanup values that are protective of groundwater and appropriate for site specific conditions, it is clear that the Esso Tutu SSL values are inappropriate for Western Auto. Site-specific cleanup values that consider the extremely low transport in the clay layer at Western Auto should be calculated.

- **SSL values for benzene should not be applied for other BTEX parameters.**

It is apparent from FS Table 2-4 that the same SSL values have been used for all of the BTEX parameters. Based on Table 1 included with EPA's comments on the draft FS, it appears as if the SSL values were determined from an analysis of benzene. Applying SSL values derived for benzene for the other BTEX parameters (toluene, ethylbenzene, and xylenes) is inappropriate and overly conservative.

The drinking water standard or Maximum Contaminant Level (MCL) value for benzene is 5 ppb, while MCL values for toluene, ethylbenzene, and xylenes are 1000 ppb, 700 ppb, and 10,000 ppb respectively. Since soil cleanup levels are a function of toxicity and mobility, the SSLs for BTEX parameters other than benzene are much too stringent. Based on toxicity alone, the SSLs for xylenes are at least 2000 times too stringent.

- **The proposed soil excavation at Western Auto is based on inappropriate data.**

The basis for the proposed soil excavation at Western Auto is presumably the comparison between the soil contaminant concentration data and SSL values presented in Table 2-4. The Western Auto soil contaminant concentration data is not appropriate for this comparison because the soil samples used in the comparison are from soil that was excavated and removed from the site. Also, as pointed out in our comments on the draft FS, the sample with the highest BTEX concentrations (SS-1) is not a soil sample. Sample SS-1 is presented as a soil sample (page 2-19; paragraph 3) but is actually a sample of product that leaked out of the waste oil vent pipe after the pipe was inadvertently ruptured during the tank removal.

In addition to the inappropriate soil data that has been used in the comparison, the SSL values are also inappropriate. As discussed above, SSL values derived for Esso Tutu are used for Western Auto, even though the geologic conditions that would determine site-specific cleanup values are significantly different for the two sites. As also discussed above, SSL values derived for benzene have been used for the other BTEX parameters, even though SSLs for the other BTEX parameters should be orders of magnitude higher than those for benzene.

- **The extent of the proposed excavation for Western Auto is not justified.**

A soil remediation option for Western Auto consisting of excavation is discussed in Section 4.6.2.5. A soil excavation volume of 181 cubic yards for Western Auto is developed in Table 4-5 and the estimated cost for the excavation option is developed in Table 5-6.

We have several concerns with this item. First, the amount of soil to be excavated should be justified. We made this comment on the draft FS and EPA apparently agreed to our comment since in their response to our comment they stated "... the FS should clearly explain how affected areas and depths were obtained for all sites." Table 4-5 provides the input values for the volume calculation, consisting of estimated depths and areas of impacted soils; however, no source or justification for these input parameters has been provided.

Second, the draft FS proposed a soil removal volume of 133 cubic yards and this value has somehow been increased to 181 cubic yards in the draft final FS. No justification was provided for the previous value in the draft FS, and no justification has been provided for the change in the value in the current version of the FS.

Finally, it is not clear that any soil at all should be removed from the site given the inappropriate soil contaminant concentration data and SSL values (as discussed above) used in the comparison that is the basis for the proposed excavation.

- **The value of the soil remediation credit is incorrect and the methodology of application of the credit is confusing.**

A "credit" for 35 cubic yards of soil previously removed and replaced with clean backfill has been included as part of the soil excavation option for Western Auto. This is stated on page 4-51 and reflected in the amount of soil to be disposed of, as indicated on Table 5-6.

The 35 cubic yard value is apparently incorrect. During soil removal associated with UST closure, 85 cubic yards of material were excavated and removed from the area. This is discussed in the ENSR June 1994 report on UST closure. In addition, Geraghty and Miller removed substantial amounts of material during the installation of monitoring well MW-24. The source of the incorrect 35 cubic yard value is not provided in the FS.

Also, the methodology for application of the credit is confusing. The proposed area of excavation at Western Auto shown on FS Figure 4-5 is largely encompassed by the area of soil removed during the tank closure activities. Figure 3 of the June 1994 UST Closure Report shows this area. Since the FS apparently proposes excavation of the same area as that previously remediated, it is not clear what is meant by a "credit" and how the credit is to be applied.

- **Discussion of remediation of the 4-inch PVC pipe should be included in an FS section on Four Winds, not Western Auto.**

Remediation of the 4-inch PVC pipe is discussed in Section 4.6.2.5, the Western Auto soil remediation section. It is stated that the "...PVC pipe is not related to Western Auto operations. However, the further investigation and possible remediation of the PVC pipe should be coordinated with Western Auto due to the proximity of the PVC pipe and the former Western Auto USTs."

As we have pointed out previously, the 4-inch PVC pipe has already been removed from the ground, not only in the vicinity of the former USTs but up to the edge of the Four Winds building where it is capped. The pipe is still intact under the Four Winds building. Remediation of the pipe should be evaluated but this effort is clearly associated with the Four Winds property, not Western Auto. Including a discussion of this effort in the Western Auto section gives the impression that it is the responsibility of Western Auto, even though a statement to the contrary has been included.

- **Capping is the most appropriate soil remediation technique for Western Auto.**

Section 4.6.2.5 discusses the two retained Western Auto soil remediation options, excavation and capping. Table 5-4 sets forth estimated capital costs for capping 117 square yards behind Western Auto.

Section 4.6.2.5 only briefly mentions capping but has a relatively extensive discussion of excavation, giving the impression that excavation is the preferred alternative. However, given the previously performed soil removal, and the impermeable nature of the clay soil in the region combined with related lack of a transport mechanism for any remaining low levels of contaminants in soil to reach groundwater, capping provides the best remedial option for this area. Furthermore, Four Winds has already capped the vast majority of this area with a thick layer of concrete. The only portion remaining to be capped is a narrow band associated with the trench left over from removal of the 4-inch pipe.

Also, the source and justification for the value of 117 square yards associated with the capping option in Table 5-4 are not provided.

- **The Gore-Sorber study results indicate that both diesel and heavy range hydrocarbons, unrelated to Western Auto operations, are present upgradient under the Four Winds building.**

On page 2-18, paragraph 2 of the final FS it is stated that "... at the Four Winds Plaza, potential impacts to soil cannot be ruled out due to the detection of elevated soil gas concentrations of diesel components." The Gore-Sorber data indeed indicate the presence of diesel range petroleum hydrocarbons beneath the Four Winds building. However, the Gore-Sorber results also indicate the presence of heavy range petroleum hydrocarbons under the building, with the highest concentrations centered under the Cost-U-Less store.
The maximum concentration of C18 compounds in the Gore-Sorber study was 2.2 μg/sorber, while the highest concentration of tridecane was 1.0 - 1.2 μg/sorber. Tridecane is representative of diesel range petroleum hydrocarbons. C18 compounds are at the upper weight range of the compounds detected by Gore-Sorbers and therefore are representative of heavy range petroleum hydrocarbons. Higher weight compounds are less volatile than lower weight compounds (such as tridecane) and thus are less amenable to soil vapor detection. Based on this, it is expected

that C18 measurements would be much lower than tridecane measurements, unless there were much greater concentrations of heavier weight petroleum hydrocarbons present. Since C18 compounds were measured at higher concentrations than tridecane, there must be significant concentrations of heavy weight petroleum hydrocarbons present under the Four Winds building.

In summary, the Gore-Sorber data indicate that both diesel and heavy weight petroleum hydrocarbons are present under the Four Winds building. This data and the other available information also indicate that the peak concentrations of this contamination are located under the building, upgradient of the former Western Auto UST location. This petroleum contamination was apparently transported into the former UST location via the 4-inch PVC pipe and the gravel layer, which acted as transport mechanisms.

- **In sum, the objective data pertinent to the soil condition behind Western Auto conclusively indicates that any contamination behind the Four Winds Plaza is an isolated condition unrelated to the Tutu Aquifer.**

The scientific data which has been gathered and analyzed pertaining to the area behind Four Winds Plaza points to the conclusion that any contamination present in the soil remained in the soil and could not have been transported to the Tutu Aquifer. The data which leads to this conclusion may be summarized as follows:

- The hydraulic conductivity of the clay soils in which the USTs were located has been measured at values of 1.2×10^{-9} and 4.3×10^{-9}, values which virtually preclude any transport. The lack of transport is demonstrated by the documented perched water table condition existing behind the Four Winds building.

- Groundwater testing and data from MW-24 conclusively demonstrates that there has been no contribution of contaminants to groundwater directly beneath the location of the former USTs.

- The area has historically been paved and, in fact, was recently largely capped with a thick layer of concrete. The only area remaining uncapped is a strip directly above the path of the 4-inch PVC pipe which was removed and capped at approximately the time of the tank removal.

- Western Auto has removed and disposed of 85 cubic yards of contaminated material near the location of the former USTs. This area was then lined with a plastic liner and backfilled with clean soil. Geraghty and Miller removed additional soil during the installation of MW-24.

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In addition, it should be noted that the most significant contamination concern at the Tutu site is the chlorinated VOC contamination of groundwater. Essentially all the discussion with respect to potential contamination at Western Auto is related to petroleum constituents. Chlorinated VOCs and, in particular, chlorinated VOC contamination of groundwater are not even an issue for Western Auto.

We appreciate the opportunity to provide EPA with comments on the FS. Please feel free to contact us with any questions that you may have on our comments.

Sincerely,

Donald Galya

Donald P. Galya, P.E.
Program Director

Don Galya for

John Bierschenk, P.G.
Senior Remediation Geologist

Eric Butler

Eric Butler, Ph.D.
Senior Consulting Chemist

THE LEAGUE
OF WOMEN VOTERS

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10 March 1996

Response to the Revised Superfund Proposed Plan
Tutu Wellfield Site, St. Thomas, Virgin Islands

The League of Women Voters of the Virgin Islands (League, LWVVI) is pleased to respond favorably to the Revised Superfund Plan for the Tutu Wellfield Site, St. Thomas, U. S. Virgin Islands. The League's Committee on Planning and Environmental Quality (PEQ) has examined all of the alternatives carefully and agree that a combination of Soil Remediation Alternatives 3 and 4, and the Groundwater Remediation Alternative 4 provide the greatest potential for protection of human health and the environment of the site.

LWVVI has two remaining concerns related to public health and acquifer testing. Regarding the testing schedule, semi-annual sampling of approximately 15 wells at or near the plume for VOCs and BNAs is recommended. This is to continue through the remedial period of 30 years. Our question is whether, if and when any of these wells are considered sufficiently safe for human consumption, the testing will be increased to a monthly (or at least bi-monthly) schedule? The rationale for this request is based on the fact that DNAPLs or contaminants from other sources could apparently enter the water at any time, and the water be totally consumed by unsuspecting buyers over the next few months before discovery.

At the March 5th hearing , one of the representatives of the Agency for Toxic Substances and Disease Registry (ATSDR) stated that the population affected by the Tutu well pollution is too small to merit an epidemiological study. This was disturbing to many in the audience. ATSDR will conduct an education program for local health care professionals to assure that they know what to look for and how to respond to the signs of disease. We believe that an intense program of this sort will certainly be very helpful, but that the dissemination of information to non-professionals is equally important - in other words, additional efforts must be made to reach the less well-educated and less environmentally aware of the community. The League would be pleased to help with publicity and with follow-up activities through the local media: news articles, radio or television programs. Please let us know how we can help.

Sincerely,

Helen W. Gjessing

Helen W. Gjessing, PEQ Chair

THE LEAGUE OF WOMEN VOTERS 75TH ANNIVERSARY 1920 - 1995

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March 13, 1996

ENSR Ref. No: 7218-001
ENSR Doc. No: 55-DPG-553

Ms. Caroline Kwan
Emergency and Remedial Response Division
U.S. Environmental Protection Agency
26 Federal Plaza
New York, NY 10278

**RE: Comments on Forensic Esso Tutu Station Report
Tutu Wells Site, St. Thomas, U.S. Virgin Islands**

Dear Ms. Kwan:

At the request of Western Auto Supply Company's attorneys, ENSR Consulting and Engineering has reviewed the February 1995 Forensic Environmental Services report "Site Remediation and Supplemental Investigation Program: Esso Tutu Service Station". This letter contains comments on that document. Comments on this document are being presented to the US EPA because of their relevance to the Remedial Investigation/Feasibility Study process.

- **The evidence for a perched water table at Esso Tutu appears to be confusing and non-convincing.**

In Section 2.1.2 (pages 2-3 and 2-4) it is stated that there is a region of perched groundwater in the vicinity of well SW-7. Hydraulic conductivity values from slug tests for wells SW-1, SW-3, MW-8, and DW-1 are presented. The lowest conductivity values are located at wells SW-1 and SW-3.

It is not clear from this information what the site specific conditions are that cause the perched water table. The lowest conductivity values are at wells SW-1 and SW-3, but apparently groundwater is not perched in those locations. Also, the hydraulic conductivity value for well SW-7 is given. Finally, the data and analyses by which the hydraulic conductivity values were derived are not presented.

- **The calculated groundwater velocity is not supported by adequate scientific justification.**

In Section 2.1.2 (page 2-4) a groundwater velocity of 4.7 feet/year is calculated assuming an effective porosity of 0.15. The actual calculation for the velocity is not shown. Assumed values of parameters such as hydraulic conductivity and the hydraulic gradient that are necessary for the calculation of groundwater velocity are not stated. Rational for the assumed porosity value of 0.15 is not provided; however, this value can range from 0 to 0.5 for various types of fractured bedrock. Also, the use of an effective porosity to calculate groundwater velocity in a fractured bedrock system assumes that an equivalent porous medium approximation is appropriate. No information is provided to justify this assumption. Finally, the calculated groundwater velocity does not appear to be correct based on the contaminant plume in the Tutu aquifer.

- **The Esso Tutu chlorinated VOC soil data do not define the limit of contamination and the existing data indicate significant contaminant levels.**

In Section 2.2.2 (page 2-7) it is stated that Esso Tutu soil samples SS-1 and SS-6 define the eastern and western extent of contamination and that Esso soil samples SS-4 and SS-5 define the north and south extent of contamination. It is also stated that Esso sample SS-1, obtained from a depth of nine feet, had non-detectable levels of chlorinated VOCs, implying that this sample defines the vertical extent of contamination.

Esso sample SS-1 does not define either the horizontal or vertical extent of chlorinated VOC contamination. The detection limit for all chlorinated VOCs in this sample was 1600 ppb, too high to be a reliable indicator of the absence of contamination. Also, significant levels of chlorinated VOCs were detected in Esso samples SS-3, SS-7, and SS-8, which are located in the same horizontal location as Esso sample SS-1. This provides further indication that the horizontal extent of contamination is not defined. Finally, it is not clear how Esso samples SS-4 and SS-5 could define the extent of north and south contamination. Both are located too close to each other and are not located to the north and south of the location of the highest detectable chlorinated VOC concentrations (Esso sample SS-3). The attached foldout figure (Figure 1) graphically portrays the PCE and 1,2 DCE soil data at Esso Tutu.

- **The groundwater and soil data indicate that there is a significant potential for a chlorinated VOC contribution to groundwater from Esso Tutu.**

Section 2.3.4 uses data from monitoring wells CHT-4, CHT-7D, MW-8, MW-10, and MW-10D to determine whether the Esso Tutu station has had an impact on groundwater concentrations of chlorinated VOCs. This determination is made using a statistical analysis of groundwater concentrations and relative weight ratios of tetrachlorethene (PCE), trichloroethene (TCE), and

1,2-dichloroethene (DCE). The analysis indicated that relative weight ratios and concentrations of PCE, TCE, and DCE were statistically similar upgradient and downgradient of the station.

This analysis does not demonstrate that Esso Tutu has had no impact on chlorinated VOCs concentrations in groundwater. This is primarily because the analysis does not consider the overall decrease or downward gradient in chlorinated VOCs in the Tutu aquifer. There is a substantial decrease in groundwater concentrations of chlorinated VOC from north to south down the Tutu valley from the Laga facility. A chlorinated VOC source in this area may add contaminants to the aquifer without causing a noticeable increase in concentrations, but may decrease the contaminant concentration gradient or rate of contaminant concentration decrease. This is, in fact, seen with PCE concentrations at the site. Calculating the concentration gradient using Geraghty & Miller PCE data reported in the RI at wells MW-1 (near Laga), MW-7 (south of Tillet), MW-8 (north of Esso Tutu), and MW-10 (south of Esso Tutu). To the north of Esso Tutu, the concentration gradients of PCE between MW-1 and MW-7, MW-1 and MW-8,and MW-7 and MW-8 were determined to be 0.36 ppb/ft, 0.37 ppb/ft, and 0.38 ppb/ft, respectively. In contrast, the concentration gradient across Esso Tutu, from MW-8 to MW-10, is 0.019 ppb/ft. These gradients provide an indication of the rate of PCE decrease in terms of concentration decrease (in ppb) per foot of distance. The substantially lower concentration gradient from MW-8 to MW-10 indicates that rate of decrease in PCE concentration across Esso Tutu is substantially less than the same rate from Laga down to Esso Tutu. This trend is graphically demonstrated in the attached figure (Figure 2) showing PCE concentration values in groundwater at monitoring wells MW-1, MW-7, MW-8, and MW-10. This information indicates that Esso Tutu could be impacting PCE groundwater concentrations.

The similarity of relative weight ratios seen in the Forensic analysis could be attributable to the relative proximity of the wells used and the pumping influence of the Four Winds wells. The Four Winds wells could have influenced the chlorinated VOC concentrations in the wells that Forensic has used as upgradient wells (monitoring wells CHT-4 and MW-8). In fact, if relative weight ratios are calculated (using data from the RI) for well MW-7, which is the nearest well upgradient of the Four Winds wells, values of 38.6%, 8.0%, and 53.4% are obtained for PCE, TCE, and DCE, respectively. The PCE and DCE relative weight ratios for well MW-7 are significantly different than the corresponding ratios for the wells near Esso Tutu, again indicating that there may be an impact on groundwater concentrations of chlorinated VOCs at that facility.

Finally, the concentrations of chlorinated VOCs in soil at Esso Tutu indicate the potential for groundwater contamination. Table 2-4 of the FS shows soil concentrations above SSLs (soil screening levels). One of the Esso Tutu samples shown in FS Table 2-4 indicates a PCE concentration of 1500 ppb at a depth of 7 feet. The SSL value at Esso Tutu is 32 ppb for PCE in soils that are greater than 4 feet in depth. It should be noted that the USEPA developed the Esso Tutu SSL values specifically to be protective of groundwater at Esso Tutu. An exceedance of the standard by a factor of greater than forty indicates a significant potential for groundwater

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contamination. At a nine foot depth in the same location as the sample discussed above, a sample with a non-detect at 1600 ppb was obtained. Both of these samples were located at depths less than 10 feet to groundwater. There was no deeper sample at this location with a relatively low detection limit. This indicates that there is a significant potential for groundwater contamination through the soil route at this location.

Please feel free to contact us with any questions that you may have on these comments.

Sincerely,

Donald Galya

Donald P. Galya, P.E.
Program Director

Don Galya for

John Bierschenk, P.G.
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December 19, 1995

Ms. Caroline Kwan
New York/Caribbean Superfund Section
U.S. Environmental Agency Region II
290 Broadway, 20th Floor
New York, NY 10007-1866

Transmittal of Comments and Concerns Related to Calculated Site Specific Soil Cleanup Standard for the O'Henry Dry Cleaners, Tutu, St. Thomas, U.S. Virgin Islands

Dear Ms. Kwan:

This letter presents comments and concerns relating to the site specific soil cleanup standard presented by the EPA as applicable to the O'Henry Dry Cleaners, Tutu, St. Thomas. The site specific standard is presented in *CDM Federal, July 1995, Final Report, Estimation of Soil Cleanup Concentrations Required to Protect Groundwater as a Source of Drinking Water.* This standard was referred to as the applicable standard by the EPA in the CDM Federal, 1995, document but is also presented in the EPA Technical Review Comments on *IT, 1995 Soil Remediation Report for the O'Henry Dry Cleaners, Tutu St. Thomas*, presented in a letter to Nancy D'Anna, Esq. from Carole Peterson received July 27, 1995, and in *Geraghty and Miller Inc., 1995, Final Feasibility Study for the Tutu Wells site, Tutu, St. Thomas.* Materials in the form of calculation sheets and a spreadsheet were supplied by the EPA on October 6, 1995, in response to a FOIA request filed by Nancy D'Anna, Esq. IT Corporation (IT) at the request of L'Henri Inc., has reviewed this computer spreadsheet in addition to the above referenced documents and has the following comments and concerns with the Soil Cleanup Concentration presented by the EPA for the O'Henry Dry Cleaners site:

Development of the site specific soil cleanup levels for the Tutu Wells site by CDM Federal was based on an EPA, December, 1994, Technical Background Document for Soil Screening Guidance (Review Draft). Formulae used for the estimation of the mixing zone depths and derivation of the dilution factor in the supplied spreadsheet were cited from the EPA document, however, the EPA document used is a draft review copy that is marked "Do Not Cite or Quote." Since this method is in review draft stage which has not undergone full EPA and public review and comment, we question the use of the method as applied through the spreadsheet by CDM Federal. IT has previously used the one-dimensional, finite difference model VLEACH to

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calculate the appropriate site specific soil cleanup standard (*IT, 1994, Work Plan for Evaluation and Interim Remediation of Soils, O'Henry Laundry, Tutu, St. Thomas, U.S.V.I.*) and as pointed out in Section 3.4 of *IT, 1995, Soil Remediation Report O'Henry Laundry, Tutu, St. Thomas, U.S.V.I. (Revision 1)*, use of the site specific Foc in the model would lead to a higher soil cleanup standard than that presented in the Work Plan (IT, 1994). The model VLEACH is listed among those appropriate to be used for site specific soil cleanup standard determination in *EPA, December, 1994 Technical Background Document for Soil Screening Guidance (Review Draft)*. Understanding that the VLEACH model is conservative in that it does not consider chemical or biological degradation, it is reasonable to expect that use of the VLEACH model would result in lower soil cleanup standards than the CDM Federal spreadsheet model using the same site specific parameters. IT believes that use of VLEACH is appropriate for calculating the site specific soil cleanup standards for this site.

Notwithstanding the above, assuming that the method applied by CDM Federal is appropriate for the calculation of site specific soil cleanup standards, following is a listing of assumptions which should be amended as indicated for the O'Henry site:

- A composite soil profile generated by CDM Federal for the O'Henry Dry Cleaners simulating the soils present beneath the contaminated zone is not representative of actual soils present at the site. The generated profile indicates that the site contains clayey sands (SC) and silty sands (SM) and clayey silts at depth intervals of 0 to 2.1 ft, 2.1 to 10.96 ft, and 10.96 to 22 ft respectively. However, visual classification of soils during soil remediation activities for the excavation area and soil boring ITSB-01 indicated that soils are uniform and predominantly sandy silt with clay (ML) from the ground surface to a depth of 8.25 ft. An andesitic unweathered bedrock underlies the silty soils. Because the soil type simulated for the O'Henry Dry Cleaners was not representative of site soil conditions, model soil parameters including the assumed water content (which was taken to be the effective porosity), total porosity, soil layer thickness, and soil mass (dry bulk density) were not accurate parameters for the site. Site specific soil parameters obtained during soil remediation activities are as follows:

  - Volumetric water content = 0.3
  - Dry bulk density = 1.53 g/cc
  - Total porosity = 0.4.

- A contaminant source length of 50 ft was used by CDM Federal for the O'Henry site. This parameter is used in the calculation of the dilution factor. A resulting dilution factor of 0.04 was subsequently used for the calculations of the target soil leachate concentration of <132 μg/L for the acceptable groundwater MCL of <5 μg/L. During soil remediation activities conducted in March 1995 at the O'Henry site, field observations indicated that a contaminant source length parallel to the groundwater flow for the site is approximately 25 feet (Note: 25 ft is used conservatively, the actual source length is probably less than 20 feet). Using the source length of 25 feet results in a dilution factor of 0.02. In addition, a lower source length results in a lower leachate flux rate of 5.025 ft^3/yr instead of the flux rate of 10.05 ft^3/yr used by CDM Federal in the soil leaching model.

- The allowable contaminant concentration in soil was calculated by CDM Federal using an foc value of 0.006 in soils above 1.6 feet and an assumed foc value of 0.0002. CDM Federal cover letter to the EPA which accompanies the CDM Federal, July 1995, report acknowledges that the model results are very sensitive to the input value for organic carbon content of the soils and states "This represents a significant uncertainty in the model results. CDM Federal **recommends that the soil cleanup goals calculated here be recalculated if additional site-specific data becomes available and revised if necessary at that time.**" The foc obtained by IT for soils at a depth of 5-6 feet at the O'Henry site indicate that foc is 0.008. Therefore, it is appropriate that the soil cleanup concentration be recalculated.

Using the Soil Screening framework as described on page 2-22 of EPA, December 1994, the simple site specific soil screening level (SSL) is backcalculated from acceptable groundwater concentrations. First the acceptable groundwater concentration is multiplied by the dilution factor to obtain the target leachate concentration. The partition equation is then used to calculate the equilibrium soil concentration corresponding to this soil leachate concentration. Using this simple methodology (ignoring chemical degradation) and using the site specific parameters as described above for PCE at the O'Henry site yields the following:

- Allowable groundwater concentration is 4.9 mg/l (i.e., <5mg/l), the site-specific dilution factor is 1/0.02, therefore the allowable leachate concentration is 245 mg/l

- Kd is calculated to be 2.18 (foc assumed to be 0.006) for soils above 1.6 feet and 2.91 (foc assumed to be 0.008) for soils below 1.6 feet, therefore the allowable soil concentration is calculated to be 534 mg/kg for soils above 1.6 feet and 713 mg/kg for soil below 1.6 feet. (Note that recalculated values through the CDM Federal spreadsheet accounting for biodegradation should result in higher allowable soil concentrations than those presented here).

The site specific soil cleanup standards for the O'Henry site were calculated by CDM Federal based on the assumption that soil remediation activities had not been performed. Soil remediation was conducted in March, 1995 for the O'Henry site. Soil left in place is represented by two distinct profiles; soil left in place at the excavation base overlain by clean backfill material and soil beneath the concrete area on the northern excavation wall. IT has presented an evaluation of impact to groundwater of the soils left in place in the revised Soil Remediation Report (IT, August, 1995) using the VLEACH model. This evaluation indicates soil left at the site will not impact groundwater to greater than the MCL for PCE.

IT, therefore, requests that EPA review the method currently used to calculate the site specific soil cleanup standards for the O'Henry site and revise these standards based on the comments presented here.

If you have any questions regarding these comments, please contact L'Henri Inc., Coumsel Nancy D'Anna, Esq. at (809) 776-6533 or me at (423) 690-3211. Additionally, please note the change of area code for east Tennessee.

Sincerely,

Belinda Price

Belinda K. Price, R.P.G.
Project Manager

cc: Andrew Praschak Esq., EPA
Leonard Reed, DPNR
Nancy D'Anna Esq.
Jack McBurney, *de maximis, inc.*

TECHNICAL REVIEW COMMENTS
SOIL REMEDIATION REPORT FOR
O'HENRY LAUNDRY, TUTU, ST. THOMAS

Reference: Letter to Nancy D'Anna, Esq., from Carole Peterson received July 27, 1995.

<u>General Comments:</u>

Comment 1: **The limits of the excavation were determined from field gas chromatograph results and using a provisional soil cleanup level of 200 ug/kg, based on preliminary vadose zone leaching modeling. The final EPA cleanup goals for the O'Henry property, based on revisions to the model, are 375 ug/kg PCE in the 0-1.6 feet depth interval, and 31 ug/kg PCE at depths greater than 1.6 ft, which will result in levels of PCE in groundwater below the MCL of 5 ug/l. These cleanup goals are developed from unsaturated zone calculations that take into account infiltration of precipitation, PCE adsorption-desorption from site soils, anaerobic biodegradation of PCE and mixing of contaminated leachate with groundwater in the underlying aquifer. Based on the final EPA calculations, additional soils remediation is needed to address potential sources of groundwater contamination.**

Response: Cleanup standards calculated by the EPA assume soil contamination occurs at the soil cleanup standard concentration for the entire soil column. Site modeling performed by the EPA and reported in specific comment No. 15 does not take into account all site specific data available. Further, IT cannot verify the results of EPA modeling presented for the O'Henry site because site specific input parameters, input/output files, and spreadsheet calculations have not been presented. However, using the leachate to groundwater dilution factor of 0.04 assumed for the O'Henry site by the EPA (CDM, 1995), and back-calculating from the groundwater MCL for PCE of 5 ppb, the equivalent concentration of PCE in leachate entering groundwater would be 125 ppb. This value is higher than the soil cleanup standard of 31 ppb presented by the EPA which would suggest that the soil cleanup standard must be greater than 125 ppb.

Based upon analytical results of the confirmatory soil samples collected during soil remediation activities and physical conditions at the site, soils left in place at the O'Henry Laundry site represent two distinct PCE soil concentration profiles.

Profile 1: <u>Soils left in place at the excavation base overlain by clean backfill material brought from offsite</u>. Analytical results indicated that soils used as backfill material from ground surface to a depth of 8.25 feet within the excavation area were clean soils with PCE concentrations below detection limits. Soils underlying the backfill material at the excavation base, at a depth of 8.25 ft and deeper, were found to contain PCE at a maximum concentration of 170 ppb. The soil boring ITSB-01 defines the limits of the contamination at 10 feet below grade (i.e., nondetect at 10 feet).

Profile 2: Soils beneath the concrete area on the northern excavation wall. Soils collected from the northern excavation wall, beneath the paved concrete slab were found to contain PCE with maximum concentrations of 38 ppb, 560 ppb, and 1100 ppb at depth intervals of 2 to 3 ft, 3.75 to 4 ft, and 5.33 to 5.88 ft, respectively. No depth limit has been defined for the contamination under the paved concrete area; however, the depth of the base of contamination was assumed to be the same as for Profile 1 (see response to Specific Comment No. 14).

Table 1 shows the two vertical distribution profiles of PCE soil concentrations. Using the above PCE concentration soil profiles and site specific soil parameters obtained during the soil remediation activities (IT, 1995), groundwater impact due to the mobilization and migration of PCE in the vadose zone was estimated using the computer program VLEACH Version 2.0 (Ravi, et al., 1993). VLEACH is a one-dimensional vadose zone model that predicts contaminant behavior within the vadose zone using a finite difference method. The modelling assumptions were the same as those described in the Workplan (IT, 1994) with the exceptions as described below.

These values were obtained during the March 1995 soil remediation activities (IT, 1995) :

- The soil type at O'Henry is predominantly sandy silt with clay soil.
- Dry bulk density = 1.53 g/mL
- Volumetric water content = 0.3

Other revised input parameters included:

- Hydraulic gradient =0.073 ft/ft (EPA Final Report, Estimation of Soil Cleanup Concentrations Required to Protect Groundwater as a Source of Drinking Water, Tutu Wells Site,USVI, 1995)

- Organic Carbon Partition Coefficient (K_{oc})=364 ml/g (EPA,1995)

- Soil organic carbon fraction (f_{oc})= 0.006 (EPA, 1995). (The more conservative of the two site specific values determined by IT and the EPA, see also the response to Specific Comment 10.)

Model data files (LHENRI for Profile 1 and LHENRI2 for Profile 2) are attached. The VLEACH model provides information on the amount of PCE released to the groundwater in terms of grams per year at every time step. PCE concentrations in groundwater due to the impact of leachate were estimated using VLEACH/mass loading estimates and a one-cell mixing model for the aquifer directly below the contaminated vadose zone. The mixing model assumes complete mixing in the water column.

PCE concentrations in groundwater $[M]_{GW}^{PCE}$ was calculated using:

$$[M]_{GW}^{PCE} = \frac{[M]_{Leachate}^{PCE}/year}{Volume\ of\ water\ flowing\ through\ unit\ width\ per\ year}$$

Where water volume = n x t x L x W

n =	porosity = 0.4
t =	aquifer thickness = 10 ft
L =	flow velocity using a hydraulic conductivity of 1.5 ft/day and hydraulic gradient of 0.073
W =	A unit cross-sectional width

Water volume = 0.4 x 10 ft x 42.37 ft/year x 1 ft
= 169.5 ft^3/year
= 4796 liters/year.

The incremental increase in PCE concentrations in groundwater for the O'Henry site using the two PCE concentration soil profiles are shown in Figures 1 and 2 respectively. Table 2 summarizes the highest groundwater PCE concentrations and the time at which the peak impact occurs beneath the site. Figures 1 and 2 show that with the current PCE soil concentration profiles, groundwater beneath the O'Henry site will not be impacted above EPA action limits. The site specific modeling will be incorporated into a new chapter titled, "Evaluation of Impact to Groundwater of Soils Left in Place."

Comment 2: **Concentrations of PCE reported in confirmatory laboratory analyses of samples were in many cases significantly higher than the field GC results, especially from the deeper samples and excavation wall samples. Usually, laboratory analyses of VOCs yield lower concentrations than do field results, due to compound volatilization during shipping and handling. The higher laboratory PCE results for many samples call into question the reliability of the field GC results to accurately determine whether residual PCE concentrations are below the provisional (or any) cleanup level.**

Response: A comparison of the PCE results from samples collected and analyzed by the field GC and in the laboratory by IT and split samples analyzed by the EPA are included on Table 4. An examination of this table indicates that the field GC analyses yielded the highest concentrations in 10 samples, the IT laboratory analysis yielded the highest concentrations in 8 samples and the EPA laboratory yielded the highest concentrations in 2 samples. The field GC result was only lower than the IT laboratory result for four samples where an EPA laboratory split sample result was not available (EXS05, EXS26, EXS27, and EXS35). Of these samples, there was only one sample (EXS27) where the IT laboratory results was more than double the field GC result (195 μg/kg from field GC and 850 μg/kg from IT laboratory). For this sample, a duplicate analysis was performed. The result (570 μg/kg) is intermediate of the field GC and IT laboratory results.

For the samples for which EPA split samples are available and where the IT (or EPA) laboratory results are higher than the field GC, four samples have laboratory results which are more than double the field GC results (EXS30, EXS31, EXS33, and EXS34). In three of these samples, the IT laboratory has the highest concentration and in one case the EPA has the highest concentration.

There are only three samples where the field GC analysis was below the preliminary cleanup standard and where the confirmation sampling analysis was above the preliminary cleanup standard (EXS27, EXS30, and EXS31). These three samples are located beneath the concrete slab on the northern wall of the excavation.

In addition, the following should be noted.

- Quality control measures were taken during field analysis to support the validity of the test method. Appropriate instrument calibrations were performed and check standards were continuously analyzed throughout the field analysis to verify correct instrument performance. Accuracy and precision data (i.e., MS/MSD samples and surrogate spikes) indicate no problem with data generated by the field GC.

- Interpretation of soil VOC data is often fraught with difficulties due to inherent problems with the sampling and analytical process. Losses of VOCs have been reported due to volatilization caused by sample disruption during <u>field</u> or <u>laboratory</u> subsampling, as well as leakage and/or transformation during preanalytical handling. VOCs may become physically entrapped in the microstructure of soils and can be difficult to desorb and remove during extraction. In addition, ancillary soil properties (e.g., water content, organic carbon content, temperature) can affect spatial variability and soil VOC behavior.

VOC concentrations vary in soils both in space and time. Therefore, variability in measurement of VOCs can be large as a result of natural variability. Focus should be on the comprehensive data sets rather than on discrete values and on the laboratory confirmation samples rather than the field GC.

The confirmation samples indicate that soils have been removed to below the preliminary cleanup standard with the exception of an area of soil beneath the concrete slab. A new subsection will be added to Chapter 3.0 titled, "Evaluation of Field Screening and Laboratory Analytical Results," which will compare the results as described above.

Comment 3: **High concentrations of PCE in the southeastern part of the excavation pit and the southern pit wall near the Liquor Barn (e.g., EXS12, EXS27, EXS30, and EXS31) indicate that not all soils containing PCE above 200 ug/kg were removed. It therefore appears that additional PCE-contaminated soils exist beneath the O'Henry building.**

Response: We agree that field GC and confirmation samples indicate that soil with concentrations above the provisional cleanup level of 200 μg/kg are left in place beneath the concrete paving at the <u>northern</u> end of the excavation. This will be incorporated in the first paragraph of the conclusions section.

Specific Comments

Comment 1: <u>Section 1.1.2, page 1-2 and 1-3.</u> **The provisional level of 200 ug/kg has been revised to 31 ug/kg for soils more than 1.6 feet below ground surface, based on EPA's final vadose zone modeling results. This information should be incorporated into the text.**

Response: The information as requested will be added to the text in Section 1.0; however, please see response to General Comment No. 1.

Comment 2: <u>Section 2.1, page 2-1.</u> **The maximum concentration of PCE previously reported in subsurface soils was 180,000 ug/kg in sample e-02-02 from a depth of 1.5-2.5 ft (Figure 5-11 of the Draft Final Remedial Investigation Report), not the 59,000 ug/kg in boring SS1 as reported here.**

Response: We agree; however, it should be noted that the soil boring SS1 was targeted to <u>the same location</u> as e02-02. Therefore, data from SS1 is more recent than e02-02. The text will be revised accordingly.

Comment 3: <u>Section 2.1, page 2-1.</u> **The sample depths of the two undisturbed soil samples that were submitted for geotechnical analyses should be listed. According to Appendix A, apparently only one of these**

samples underwent analysis. The text here and on page 3-3 should clarify the depth interval sampled and that only sample LH01 and its duplicate were analyzed.

Response: We agree; two samples (i.e., one sample LH01 and its duplicate LH02) were collected; however, only one sample, LH01 from a depth interval of 5 to 6.5 feet, was analyzed for geotechnical parameters. The text will be revised accordingly.

Comment 4: **<u>Section 2.2, page 2-1.</u> Here and elsewhere, the text should indicate that the cleanup level of 200 ug/kg was an <u>assumed</u> cleanup level and was used provisionally.**

Response: We agree. The text will be revised accordingly.

Comment 5: **<u>Section 2.6, page 2-6.</u> The text indicates that a PID was not available during installation of boring ITSB-01. Presumably the PID had arrived by the time of the soil excavation work, yet no organic vapor readings are presented in any section of the report. If PID readings are available they should be discussed in the text because they would aid in identifying contaminated soil zones within and adjacent to the excavated area.**

Response: Table 3 summarizes PID readings taken during soil remediation activities. PID readings will be included in the report.

Comment 6: **<u>Section 3.1, page 3-1, second paragraph.</u> PCE concentrations of up to 2,845 ug/kg were found at a depth of 3-4 ft at location EXS12. Table 3-1 indicates this is an estimated concentration since the value exceeded the instrument calibration range. The text should be revised to discuss how large this estimated result could potentially be.**

Response: The reported value from sample EXS12 is reported as an estimated concentration. A sample aliquot of 0.5 g was used for analysis; the analytical results exceeded the calibration linear range. Due to problems obtaining additional supplies, the sample was not reextracted and reanalyzed with a smaller aliquot. A smaller sample aliquot would have allowed the analytical result to be within linear range; thus a more accurate value would be reported. The reported result is most likely slightly higher than the actual concentration. This will be added to the text.

Comment 7: **<u>Section 3.1, page 3-1, third paragraph.</u> Soil samples collected from the excavation wall adjacent to the concrete slab exceeded the provisional PCE cleanup level of 200 ug/kg. Given that the EPA has established an even lower soil PCE cleanup goal to be protective of groundwater, the report should discuss the potential for the**

residual contaminants at these sample sites (and others exceeding the cleanup goals) to serve as ongoing sources of groundwater contamination.

Response: See response to General Comment No. 1.

Comment 8: Table 3.2. Please include a brief discussion of the data qualifiers used in this table, particularly the "D" qualifier, in the associated text on page 3-2.

Response: Explanation of data qualifiers will be added to the text.

Comment 9: Section 3.2, page 3-2. Based on Tables 3-1 and 3-2 and the associated figures, almost half of the samples that underwent both CLP and field GC analysis show higher PCE concentrations in the CLP results than the GC results. See General Comment 2. The text on page 3-2 should discuss why this is the case, and how this finding may affect interpretation of all of the field GC results.

Response: See response to General Comment No. 2.

Comment 10: Section 3.3, page 3-3. The organic carbon content is reported as 0.015 (1.5 %) in a sample collected from a depth of 5 - 6.5 ft. This value is almost three times higher than the value reported from the O'Henry property from two EPA samples collected from the top two feet (average TOC = 0.6 %), and much higher than the organic carbon values of 0.0002 (0.02%) to 0.001 (0.1%) used by IT in the VLEACH modeling. The report should discuss the representativeness of this value relative to other site-reported or assumed TOC values, and its implications for PCE movement through the soils. The ASTM method (D2974-87) used by IT is a combustion/incineration method that will also count inorganic carbon (e.g., carbonate and bicarbonate), unless it is deliberately removed during the sample preparation stage. (The Lloyd Kahn method, "Determination of Total Organic Carbon in Sediment", 1988, which is often used by EPA, includes an acid treatment step during sample preparation to remove inorganic carbon.) Given the presence of carbonate rocks in the area, eroded carbonate material is probably present in many Tutu soils. This could account for the higher values reported in the subsurface by IT versus the surface soil values reported by EPA.

Response: Section 3.3, page 3-3 on geotechnical testing incorrectly reports the results of ASTM D-2974 as fraction of organic carbon. The actual parameter measured by ASTM D-2974 is the fractional organic material contained in the sample. As reported in Appendix A of the document, the two analyses performed by ASTM D-2974 produced fractional organic material results of 0.015 and 0.013. The fraction of organic material can be related to the fraction of organic carbon by dividing by 1.724 (Dragun, J. 1988). Following this approach, and using the average fraction of organic material (0.014), yields a fractional organic carbon content of 0.008 or 0.8 percent. The model VLEACH uses "organic carbon fraction" as an input parameter which is why the ASTM method was applied by IT.

The percentage of organic carbon calculated by IT is, therefore, comparable with the percentage of total organic carbon as presented by the EPA. The fraction organic carbon value used by IT in calculation of the PCE cleanup standard using VLEACH (IT, 1994) was lower than the values determined from laboratory tests. The effect of using a higher fraction organic content in the previous modeling would have resulted in a higher cleanup standard. This will be added to the text.

Comment 11: **<u>Section 5.0, page 5-1, first sentence.</u> Based on the residual PCE contamination greater than 200 ug/kg detected in soils in the excavation pit southeastern wall, this sentence should be revised to indicate that not all of the source of potential groundwater contamination at the O'Henry site has been removed.**

Response: See response to General Comment No. 3.

Comment 12: **<u>Section 5.0, page 5-1, second bullet.</u> The argument that the average PCE concentration is soils is nearly equal to the provisional cleanup level, when the reported PCE concentrations are as much as five times greater than the provisional level, is not valid. The text must be revised.**

Response: We agree. See response to General Comment No. 1.

Comment 13: **<u>Section 5.0, page 5-1, second bullet, final sentence.</u> The report states that, due to the distance to the water table (approximately 16 feet), PCE concentrations much greater than 200 ug/kg would be needed to result in detectable concentrations of PCE in groundwater. Based on EPA's soil leaching modeling, this statement is not true. Attached is a new soil profile constructed for the O'Henry property using the maximum residual contamination remaining at each depth in soils, post-excavation, <u>as reported in the IT soil removal report</u>. The site-wide values for infiltration, Kd and biodegradation were used. The corresponding contaminant breakthrough curve indicates that leaching of these soils will result in concentrations of PCE in groundwater of approximately 30 ug/l in the future, well above the drinking water standard of 5 ug/l.**

The EPA model assumes a low organic carbon content in the deeper soil horizon, but allows for anaerobic biodegradation of PCE throughout the soil column. The modeling indicated that almost no

compound attenuation occurs in the deeper zone, due to the low organic carbon content and biodegradation rate loss terms used. Furthermore, PCE volatilization is predicted to be a very minor attenuation process at depths below about 1 meter due to the presence of anaerobic breakdown products found in soils below this depth. Therefore, PCE will migrate in leachate relatively unattenuated to the water table, regardless of the distance of the source from groundwater. The text should remove this statement.

Response: Please see response to General Comment No. 1.

Comment 14: **__Section 5.0, page 5-2.__ The text states that PCE concentrations were below detectable levels beneath 10 ft in boring ITSB-01. The report should indicate, however, that this boring may not be indicative of concentrations in surrounding soils. Based on sampling results shown in Figures 2-4 and 2-7, the higher PCE concentrations exist in nearby soils.**

Response: Based on an evaluation of the spatial PCE concentrations from field GC and laboratory confirmation sampling shown in Figures 2-3 through 2-7 of the report, the depth profile for PCE concentrations in boring ITSB-01 appears representative of the depth profile of PCE concentration in soil in the excavation area. PCE which may have entered soil and migrated from the unpaved area back under the concrete will have the following characteristics:

- It is unlikely to have migrated more than a few feet horizontally.
- It will not volatilize as fast because it is effectively "capped."
- It will not migrate vertically downward in the dissolved phase as fast because there is a reduced driving force (i.e., lower infiltration).

Given the above characteristics and visual observations which indicate no residual free phase in soil and no vertical pathway for preferred contaminant migration (soils are uniform) the contaminant profile in boring ITSB-01 may not be indicative of concentrations in soils beneath the paved area in terms of actual concentrations; however, it likely accurately reflects the "general profile" where the maximum concentration of PCE in soil is between 5 and 10 feet below grade and there is non-detect below 10 feet. This will be added to the text.

Comment 15: **__Section 5.0, page 5-2, first paragraph, last sentence.__ The report states that excavation of soils to a depth of 8 ft has removed all PCE-contaminated soil. Given the sampling results provided in the report, this is a false and misleading sentence which must be revised.**

Response: See response to General Comment No. 3.

Comment 16: Section 5.0, page 5-2. **The report recommends that no further in situ remediation be performed at the site. However, the revised EPA soil action levels for PCE indicate that the concentrations of PCE remaining in soils in the vicinity of the excavation will be ongoing sources of PCE contamination of groundwater above MCLs. Based on the site findings and EPA's soil action levels, some form of additional soil remedial action is required. The use of soil vapor extraction (SVE) and angled extraction wells, for example, could be effective in removing residual PCE beneath the adjacent building.**

Response: See response to General Comment No. 1.

References

CDM Federal Programs Corporation, 1995, *Final Report Estimation of Soil Cleanup Concentrations Required to Protect Groundwater as a Source of Drinking Water, Tutu Wells Site, U.S. Virgin Islands.*

Dragun, J., 1988, *The Soil Chemistry of Hazardous Materials*, Hazardous Materials Control Research Institute.

IT Corporation, 1994, *Work Plan for Evaluation and Interim Remediation of Soils O'Henry Laundry, Tutu, St. Thomas, U.S. Virgin Islands.*

IT Corporation, 1995, *Soil Remediation Report, O'Henry Laundry, Tutu, St. Thomas, U.S. Virgin Islands.*

Table 1

Concentration Profiles Used in the Model
O'Henry Laundry, St. Thomas, U.S. Virgin Islands

Concentration Profile No.	Depth Interval (ft)	PCE Concentration (ppb)
1	0 - 8.25 8.25 - 10	0 170
2	0 - 3 3 - 5 5 - 10	38 560 1100

Table 2

Highest Groundwater PCE Concentrations
O'Henry Laundry
St. Thomas, U.S. Virgin Islands

	Concentration Profile No. (Refer Table 1)	Highest Groundwater PCE Concentration (µg/L)	Time for Peak Impact (Years)
Beneath Excavated Area	1	0.026	76
Beneath Paved Concrete Area	2	0.44	90

Table 3

Summary of Organic Vapor Readings
O'Henry Laundry
St. Thomas, U.S. Virgin Islands

Sample No.	PID Reading (ppm)
EXS06	2
EXS07	0.1
EXS08	22
EXS09	34
EXS10	0.2
EXS11	0.25
EXS12	0.5
EXS13	1.8
EXS14	1.8
EXS15	0.1
EXS16	0.3
EXS17	0.5
EXS18	1.0
EXS19	0
EXS20	0
EXS21	0.5
EXS22	1.0
ESX23	2.0
EXS24	1.0
EXS25	4.0
EXS26	1.5
EXS27	1.5
EXS28	11.0
EXS29	3.0
EXS30	3.0
EXS31	7.5
EXS32	1.0
EXS33	4.0
EXS34	2.0
EXS35	0.5

Table 4

A Comparison of PCE Results (µg/kg)

Sample Number	Field GC	IT Laboratory	EPA Laboratory
ITSB-01-05.0	**237.69***	120	
ITSB-01-10.0	**12.38**	2 J	
ITSB-01-14.5	4.33/4.98	11 U	
EXS01	**214.40**	140 D	
EXS02	**197.26**	120	
EXS03	**181.34**	54	
EXS04	**324.09**	100 D	
EXS05	83.95	**100**	
EXS23	275.38	**290 D**	100 J
EXS24	**57.80**	21	2 J
EXS25	173.90	190	**210 J**
EXS26	220.33	**300 D**	
EXS27	195.14	**850 D/570 D**	
EXS28	**242.71**	210 D	220 J
EXS29	**171.46**	150 D	
EXS30	155.45	**1100**	480 J
EXS31	169.41	560 D	**630 J**
EXS32	**63.61**	38	34 J
EXS33	15.17	**31**	30 J
EXS34	74.60	**170**	30 J
EXS35	109.65	**160**	

*Highlighting indicates which analytical method yielded the highest concentration for each sample.

FIGURE 1

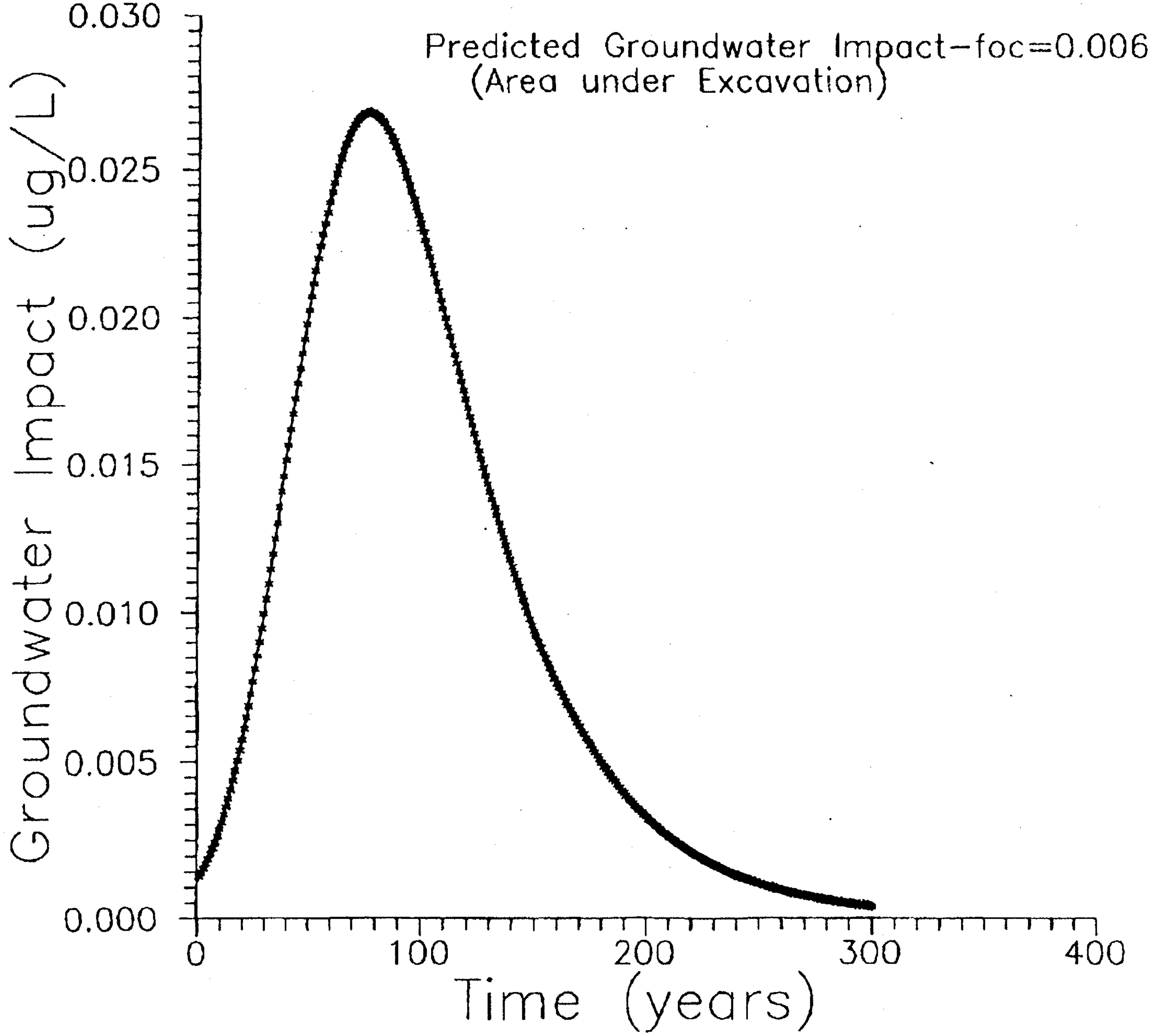
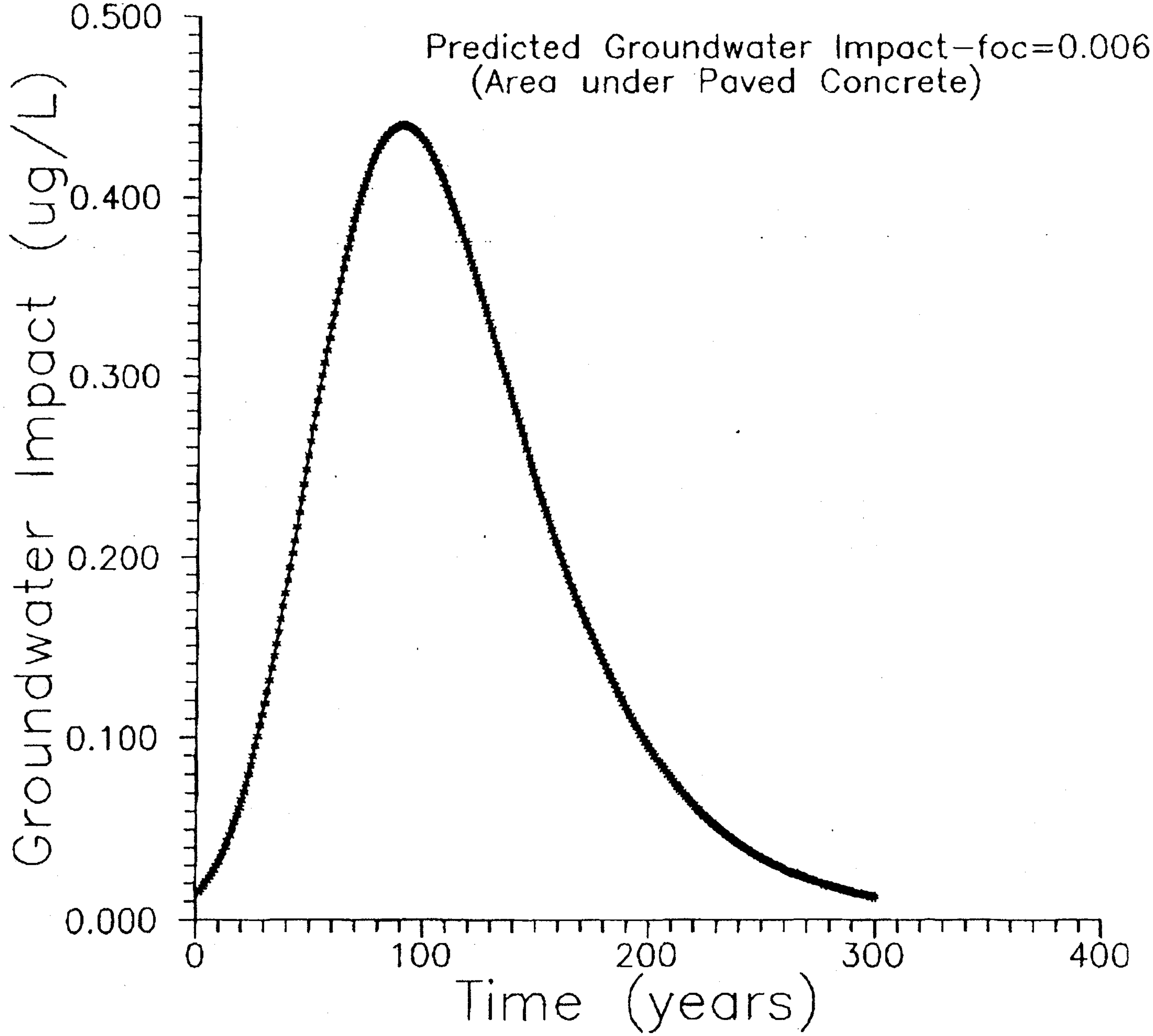

Predicted Groundwater Impact-foc=0.006
(Area under Excavation)
Groundwater Impact (ug/L)
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
100
200
300
400
Time (years)

FIGURE 2



Predicted Groundwater Impact–foc=0.006
(Area under Paved Concrete)
Groundwater Impact (ug/L)
0.500
0.400
0.300
0.200
0.100
0.000
0
100
200
300
400
Time (years)

Comments on Geraghty and Miller, Inc. 1995, Draft Feasibility Study Tutu Wells Site, St Thomas, U.S. Virgin Islands

Section 2.1.1.3. Groundwater flow direction is still not sufficiently well understood in the deep bedrock aquifer in the southern portion of the Tutu "site" ie south of the Esso station. No measured groundwater elevations were used between the locations SW-6, MW-21D, MW-22D and west of these wells, an area of 1,000 ft x 1,500 feet. Groundwater contours representing deep bedrock groundwater flow beneath the following properties should be dashed: O'Henry laundry, Liquor Barn, and Archies Welding. The map included in Graves and Gonzales 1988, used as justification for the "generalized regional flow" presented by Geraghty and Miller, indicates a lower level of detail (contours are shown at no less than ten foot intervals) than included on figure 2-4 (contours are shown at five foot intervals). It is not appropriate to use the 5 foot contour intervals. In addition, the Graves and Gonzales map uses "dashed" (indicating approximately located) and "queried" (indicating uncertain) contours over much of the area and particularly the area to the south and southeast of the O'Henry laundry. Further, the text included in Graves and Gonzales 1988 states "Several wells were being pumped, or had just terminated, when the water levels were measured ...These water levels reflect a pumping or recovery condition; therefore, static water-level conditions throughout the Turpentine Run basin at the time of measurement cannot be assumed". Because the flow map presented by Geraghty and Miller (figure 2-4) shows a non-unique solution, the positioning of the recovery wells RW-2, RW-3 and RW-5 may be inappropriate. Also, please explain why data from MW-22D is included on both the shallow and deep flow maps.

Section 2.2.2.1. First Paragraph. Since there is no such compound as "Total chlorinated VOC", the shape of each individual VOC compound plume should be discussed. The edges of the plumes should be defined as the drinking water standard (DWS) for each individual compound (where a DWS exists). What is meant by "The southern plume **originates** near the O'Henry Dry Cleaners"? Regardless of the current location of chlorinated VOCs in the groundwater, the **origin** of these chlorinated VOCs in groundwater south of the O'Henry property is unknown.

Third Paragraph. According to the shallow bedrock groundwater flow map presented in figure 2-3, monitoring well OHMW-04 is located sidegradient to the O'Henry Dry Cleaners not downgradient as stated in the text.

Section 3.4.2. The practicality of a centralized groundwater treatment system and use of POET systems on domestic and commercial wells is questionable. The use of a centralized groundwater treatment system will require piping from one end of the Tutu area to the other with associated problems due to the hilly nature of the site. This brings up questions of access, liability if pipes leak or are damaged, and maintenance. Likewise, future liability is a potential issue if monitoring indicates that contaminants are present in the effluent water of a permitted domestic or commercial wells. These issues should be very carefully considered before including a centralized groundwater treatment system and POET systems on domestic and commercial wells as part of the site remedy.

Section 4.4. Since the FS apparently chooses two alternatives (SWRAs 4 and 7) which is the SWRA advocated?

Section 4.5. The following activities are recommended to be included in the pre-design activities (and costs):

Pre-design work plan and reports of work performed.

Placement of additional deep bedrock monitoring wells in the area identified in the comment on section 2.1.1.3 above and additional groundwater level monitoring including wells not currently included on the flow maps to determine whether the assumed groundwater flow south of the Esso station is correct.

Groundwater modeling should be conducted to explore the limits of contaminant movement and to demonstrate that the proposed groundwater extraction well scenario will effectively capture the plume. Because of the uncertainty in flow direction in the area south of the Esso station it is recommended that a sensitivity analysis be performed assuming a southwesterly flow direction to the Kentucky Fried Chicken property and a southeasterly flow direction thereafter to test the recovery well scenario if Geraghty and Miller are incorrect in their interpretation of flow direction.

Figure 4-7. Areas marked as suspected to contain DNAPL do not appear to be consistent with the contaminant plumes drawn. For the area drawn near the O'Henry Dry Cleaners, the DNAPL plume extends outside the 10 ppb "total VOCs" contour. Please explain the rationale for the extent of the suspected DNAPL areas shown.

The locations of recovery wells should take into account the presence of individual compounds of concern (not just the "total VOC plume"). By considering just the "total VOCs" the recovery wells may not be appropriately located. Individual compound maps should be presented and an analysis as to the appropriateness of the recovery well network to recover the individual compounds of concern should be addressed.

Why does the map list only selected data for selected wells. Explain the rationale for only presenting certain data. In addition, it appears that not all of the available data has been used to construct the "total VOC" plume, for example data for MW-15 has not been incorporated. Please explain.

Comments on Cost Estimates Provided. Note that a detailed review was performed of the cost estimate for SWRA 4 (Table 4.9) because this was the (assumed) preferred alternative. Comments on this cost estimate are also applicable to other SWRA cost estimates.

The following are comments on the Groundwater Treatment Capital Cost:

The unit cost for Deed Restrictions seems low.

Explain what is included in Site Preparation/Mobilization. How many locations are included? (ie does it include site prep for the treatment system location, piping locations and recovery well locations?)

Clarify how many wells are included in Well Abandonment. How will the wells be abandoned. Does the cost include work plan and reporting requirements?

Does Site Acquisition mean purchase or lease? Is it for the site for the groundwater treatment system only or does it include piping locations and recovery well locations? If land is to be purchased, what will be final disposition after the end of the remediation. Also does the O&M costing include any taxes to be paid.

A detailed breakdown of the Groundwater Extraction System costs should be provided. Does this also include the trenching and filling for underground piping installation for piping to the centralized treatment system? If so, how will leak detection be accomplished?

What is included in Pre-Treatment? A scale inhibitor and metals treatment should be included. In addition, a bench-scale test will be required to estimate the chemical dosage so that adequate pre-treatment is performed.

Does the cost for the Low Profile Air Stripper include installation? The cost provided seems low for two air strippers in series.

Does the Liquid Phase Carbon Treatment System include one or two beds?

How many Process Pumps are included and are these Process Pumps and Piping and Discharge Pumps and Piping just for the treatment system? State how many pumps and the length of piping.

What is the assumed size of the Aboveground Storage Tank? Does the unit cost include shipping and installation?

Make sure that the cost for the Treatment Building includes cost for a foundation.

Is Electric for just the central treatment system or for the recovery well sites also?

Each of the POET systems may need individual design. For example they may need individual design for electrical work and housing.

The following are comments on the Soil Treatment Capital Cost:

The cost of Excavation/Disposal, Site Restoration and Excavated Soil Sample Analysis is much too low. Will individual Corrective Action Plans be prepared? Does the cost include preparation of reports? How will the soils be disposed? It would be much more practical to build soil venting piles or to perform other on-site treatment of excavated soils. How many samples will be collected per site? What analyses will be performed? Does the cost include data validation? This cost item should be broken down on an individual site basis.

Why is the cost for the SVE system at the Curriculum Center so much higher than the other sites? Detail should be provided for each site such as size of the vacuum blowers, number of extraction wells, piping details, treatment of condensate, and installation cost.

Does Engineering include detailed design, material balance, drawings, and preparation of specifications and bid packages?

Does Construction Supervision include installation of the systems? Does it include a Health and Safety Officer at the site during construction?

The following are comments on the Operations and Maintenance Cost:

Where is the cost included for an Operations and Maintenance Plan?

O&M cost should be included for the domestic and commercial wells set up with POET systems. This should include scheduled maintenance, sampling, and reporting.

How many and which wells are included in Groundwater Monitoring (ie recovery wells, monitoring wells, domestic and commercial wells)? Does the unit cost include semi-annual reports? Does the cost include Quality Control samples and data validation?

The Electricity will supply approximately 30 Hp. Is this just for the treatment system or does it include recovery wells also?

Does the cost for carbon replacement include the disposal of spent carbon?

Does Treatment System Monitoring include both air and water sampling (influent and effluent)? What will they be analyzed for? Does the cost include Quality Control samples and data validation? Does the cost include reports?

Does Administration include data reporting or is it just project management?

Does Equipment Replacement include installation cost?

In addition the following observations are made concerning the cost buildup:

Pre-design activities as described in Section 4.5 have not been included in the cost estimates. For example SVE pilot test, bioventing pilot test if appropriate, air stripper pilot test, and metals removal pilot test should be included in the cost. This appears to significantly underestimate the final cost of remediation.

Cost does not appear to include: preparation of plans, O&M manuals and reports; start up costs; licenses, permits and legal fees; insurance and bonds.

Shipping and travel may be underestimated.

Demobilation and decommissioning of recovery wells, SVE systems and the groundwater treatment plant should be included. In addition, closure and post-closure activities should be included in the cost.

Cost should be included for air emissions evaluation and permit application.

Comments
Final Remedial Investigation (RI) Report
Tutu Wells Site, Tutu, St. Thomas
Report Prepared by Geraghty and Miller (April 1995)
Comments by IT Corporation for L'Henri Inc. (June 7 1995).

GENERAL COMMENTS

1. <u>Deep groundwater flow in the area around and hydrogeologically downgradient of the O'Henry Dry Cleaners is inconsistent between the two groundwater flow maps presented.</u>

   The deep groundwater elevation contour maps presented in the RI are inconsistent with each other for the area around and hydrogeologically downgradient of O'Henry Dry Cleaners. The May 10, 1994 groundwater flow map is the most appropriate because the map includes data from wells Steele, Harvey, Eglin II and Eglin III (wells that are in the immediate vicinity of the O'Henry facility) which are not included on the May 23-24, 1994 map. Groundwater data from these wells indicates a groundwater "high" extending from Eglin I to Steele which approximately coincides with the topographic high (this is missing on the May 23-24 map). From the Eglin well area, groundwater and consequently contaminants would move to the southwest (beneath the O'Henry Dry Cleaners), south (toward the Steele well) and southeast (toward the LaPlace well). Data from the Geraghty and Miller pump test at Eglin indicate a preferential flow path southeast from Eglin (interpreted as fracture flow). In addition, shallow groundwater flow supports a local southwesterly flow direction in the immediate vicinity of O'Henry (in general shallow and deep groundwater flow would be expected to be similar).

2. <u>Presentation of individual chemical compound plumes (specifically chlorinated solvents) are not consistent with groundwater flow maps in the area around and hydrogeologically downgradient of the O'Henry Dry Cleaners.</u>

   This is the first time individual compound plume maps have been presented for Tetrachloroethene (PCE), trichloroethene (TCE), 1,2-Dichloroethene (1,2-DCE), vinyl chloride and methyl tert butyl ether (MTBE) therefore this is the first opportunity to comment on them.

   The presentation of PCE, TCE and 1,2-DCE in shallow groundwater (figures 5-25, 5-27 and 5-29 respectively) are not consistent with groundwater flow maps for the shallow groundwater (figures 4-12 and 4-13) as presented in the RI. To develop more defensible plume maps for these compounds, flow lines were drawn on figures 4-12 and 4-13 (attached). Then flow lines were transferred to the plume maps and the plumes redrawn to take into account the flow directions (attached). These redrawn maps indicate that the PCE, TCE and 1,2-DCE plumes in the shallow groundwater are located further to the west than shown in the RI and are elongated to the south rather than to the southeast (as shown in the RI).

   The presentation of PCE, TCE and 1,2-DCE in deep groundwater (figures 5-26, 5-28 and 5-30 respectively) are not consistent with the appropriate deep groundwater flow map (see

TUT 008 0900

comment 1 above) for the deep groundwater (figure 4-14) as presented in the RI (figure 4-14). To develop more defensible plume maps for these compounds, flow lines were drawn on figure 4-14 (attached). Then flow lines were transferred to the plume maps and the plumes redrawn to take into account the flow directions (attached). The redrawn plume maps (which include a 5 ppb line for TCE) indicate similar patterns for the PCE, TCE and 1,2-DCE plumes, showing a wider plume in the area extending from the Eglin well to the LaPlace well as reflective of the divergent groundwater flow. Further it should be noted that no groundwater elevation data is available south of MW-22D therefore the plume is conjectural downgradient of that location.

In addition, the outermost contours presented for individual compounds in the RI should be revised to reflect the EPA MCLs. This is valid since the data is not generally constrained by non detect values (presumably 10 ppb was used as the outermost contour to reflect the detection level for these compounds).

3. <u>Inappropriate interpretation of VOC plumes in groundwater</u>

The RI states that there are two plumes of VOCs. This is misleading and is an inappropriate interpretation. It appears from the text that a "plume" is defined as an area with greater than 10 ppb total VOCs. However, there is no technical basis for this definition. A more valid interpretation should be based on the individual VOC compounds. Further, there is no technical basis presented for using 10 ppb (apparently an arbitrary number) as the limit of the contamination for total VOCs or for the individual compounds. The contaminant maps for PCE are the most appropriate to discuss the extent of contamination in the Tutu area. The contaminant maps for PCE (figures 5-25 and 5-26) indicate three areas with PCE greater than 100 ppb in the shallow groundwater (referred to herein as the northern, central and southern hot spots), but a more diffuse plume in the deep groundwater. This pattern appears similar for other individual chlorinated VOCs.

There is no discussion in the RI of the central PCE hot spot, except to refer to it as a subset of the "northern plume". This is a significant area and warrants discussion.

In the text discussing the "southern chlorinated VOC plume", a statement is made that the "100 ppb contour extends from the Harvey Supply Well to the Smith Supply Well". This infers a flow path between the two wells which is clearly impossible when considering the flow maps.

4. <u>Misinterpretation of the significance of Esso as a source of potential contamination</u>

Criteria for evaluating whether a property represented a source of impact to groundwater are presented on page 5-33 of the Final RI. These criteria are as follows:

- "If impact to soil at a property was established based on the NYS TAGM values, and similar constituents were found in the groundwater at or downgradient of the property at higher concentrations than upgradient, the property was considered to represent a source of impact to groundwater.

- If organic compounds were detected in groundwater at concentrations in excess of 1 percent of their aqueous solubility at a property, these detections were viewed as an indication of the possible presence of nonaqueous phase liquids (NAPLS) in the unsaturated or saturated zone. The property was therefore considered to represent a source of impact to groundwater."

Showing the groundwater flow lines on the contaminant plume maps indicates that the majority of the VOCs in the southern portion of the aquifer did not originate from the O'Henry Dry Cleaners. Additional evidence for this position is provided in the analysis of MTBE, a gasoline additive. MTBE has contaminated the deep aquifer in an area extending south from the Texaco station, past the Esso station to the Delegarde Well. Note that MTBE is found at low concentrations in wells near the O'Henry facility. Since MTBE is a compound which moves quickly with the groundwater, it can be considered as a tracer for any chemicals emanating from the gas stations. Therefore, MTBE can be used to trace the general direction of groundwater flow (and therefore direction of chemical movement) from Esso to the south. Since MTBE did not originate at the O'Henry Dry Cleaners and MTBE is found in drinking water supply wells Eglin I, Eglin III, Harvey, Steele, LaPlace, Smith and Delegarde, downgradient of the Esso facility, the Esso station *MUST* be considered a source to impact to groundwater all the way to the Delegarde well.

5. <u>Inappropriate and inadequate evaluation of the sanitary sewer system as a source of contamination.</u>

The RI inadequately addresses historical sources to the sanitary sewer as a potential source of contamination to the subsurface. For example, the report ignores the fact that the waste oil holding tank (used to dispose of VOCs) was emptied directly into the toilet (therefore directly entering the sanitary sewer system) at the Esso station (Soil Tech, 1990).

Chlorinated VOCs detected in the storm sewer at the Esso station is attributed in the RI to infiltrating groundwater because Blasland, Bouck and Lee (Esso's consultant) "observed groundwater infiltrating into the sewer" when the sample was collected. Further, the assertion that the storm water sewer occurs within the water table in this area is based on one reading from one location therefore this assertion is an assumption, not a conclusion as presented in the RI report.

The discussion in the RI of the sanitary sewer results infers that O'Henry is a current source of VOCs to the sanitary system because "the highest concentrations of chlorinated VOCs were found in the sanitary sewer samples from O'Henry". This is misleading for several reasons:

- The "samples" at the sewer near O'Henry are actually one sample and its duplicate.
- The text implies that the water in the sanitary sewer is from O'Henry. In reality, water enters the sewer from a variety of sources, including the Tom Cat laundry. As has been pointed out to Geraghty and Miller on several occasions, at the time when the sample was collected from the sewer, water was flowing into the sewer

from the north side (from the Tom Cat laundry). The Tom Cat Laundry uses water from the Eglin supply wells in its machines without prior treatment therefore the water entering the sewer (and therefore sampled by ADL) is effectively Eglin well water.

6. <u>Misinterpretation of O'Henry Dry Cleaners as one of the main source areas for the southern plume.</u>

The RI claims that O'Henry Dry Cleaners is "the main" and "the principal source of the southern chlorinated plume". The basis for this statement is that "In the southern chlorinated plume, relatively high chlorinated VOC concentrations have been detected in the vicinity of and downgradient of O'Henry". Further, the RI claims that "This conclusion is confirmed by the high concentrations of PCE in soil from this area". These claims are not supported by the data for the following reasons:

- Since "Relatively high concentrations" is not defined it is not known what is meant by this.
- Chlorinated VOCs detected in groundwater in the vicinity of O'Henry may have originated at any source upgradient. The presence of elevated VOCs does not logically lead to the conclusion that the property is a source.
- Consideration of the groundwater flow maps together with contaminant concentration maps indicate that it is unlikely that contaminants entering the groundwater at O'Henry have contaminated the Steele, LaPlace, Smith , Mathias and Delegarde wells.
- Data recently obtained during the soil removal action at the O'Henry Dry Cleaners confirm that no DNAPL is present in the soils (Soil Remediation Report, IT, May 1995). Further, during the soil removal action, soil samples were collected from a boring placed where previously the highest levels of PCE detected in soils were found. The soil samples indicated that no PCE is present in soils below 10 feet. Note that the unsaturated zone extends to approximately 20 feet at this location.

7. <u>Comments Concerning DNAPL evaluation.</u>

The Final RI discussion of the likely presence of DNAPL indicates a high probability of a DNAPL release at the O'Henry Dry Cleaners based on the historical use of PCE as a dry cleaning solvent using the criteria set forth in EPA 1992b. This is inappropriate use of this EPA publication where the goal is to provide guidance for site characterization. The Final RI states that the concentrations of PCE in soils found at O'Henry are not high enough to conclude that PCE is present as a separate phase in soils. Data recently obtained during the soil removal action at the O'Henry Dry Cleaners confirm that no DNAPL is present in the soils. (Soil Remediation Report, IT April 1995).

Evidence used in the Final RI to indicate that DNAPL is present in the groundwater beneath the O'Henry Dry Cleaners is that concentrations of PCE in groundwater samples from two sampling rounds (between 1987 and 1991) were at levels which exceeded 1 percent of the solubility. This may indicate that free-phase existed before 1991. However, concentrations of PCE in groundwater samples collected from the Harvey supply well since 1991 have been much lower, indicating no free-phase since 1991. Therefore there is no evidence to conclude that PCE is present as a separate phase in groundwater beneath the O'Henry Dry Cleaners.

If it is assumed that the criteria provided in the Final RI for determining the high probability of DNAPL in groundwater is correct, then historical data provided for the Tillet supply well indicate that this area should also be identified as an area suspected to contain DNAPL in the saturated zone.

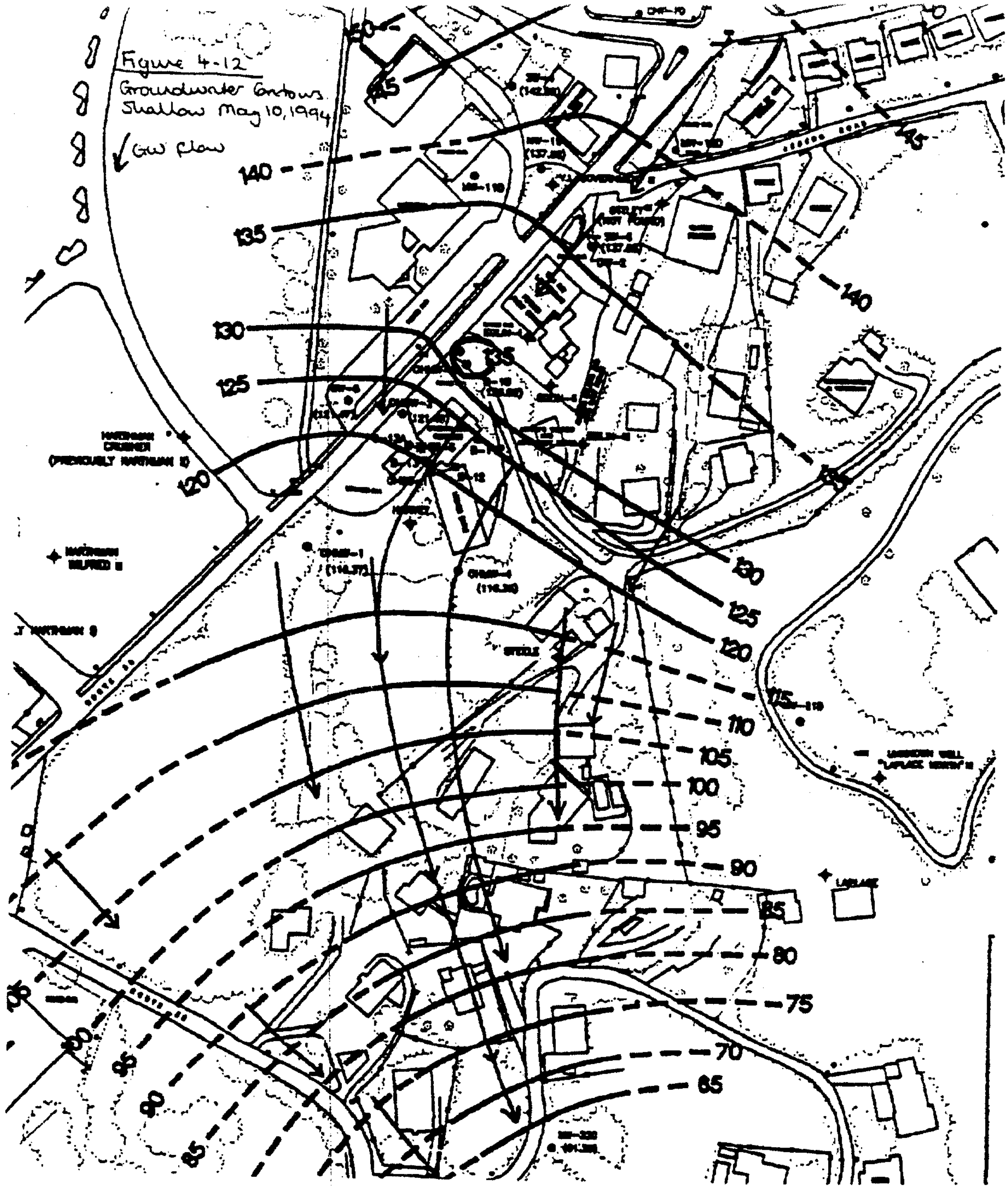


Figure 4-12
Groundwater Contours
Shallow May 10, 1994

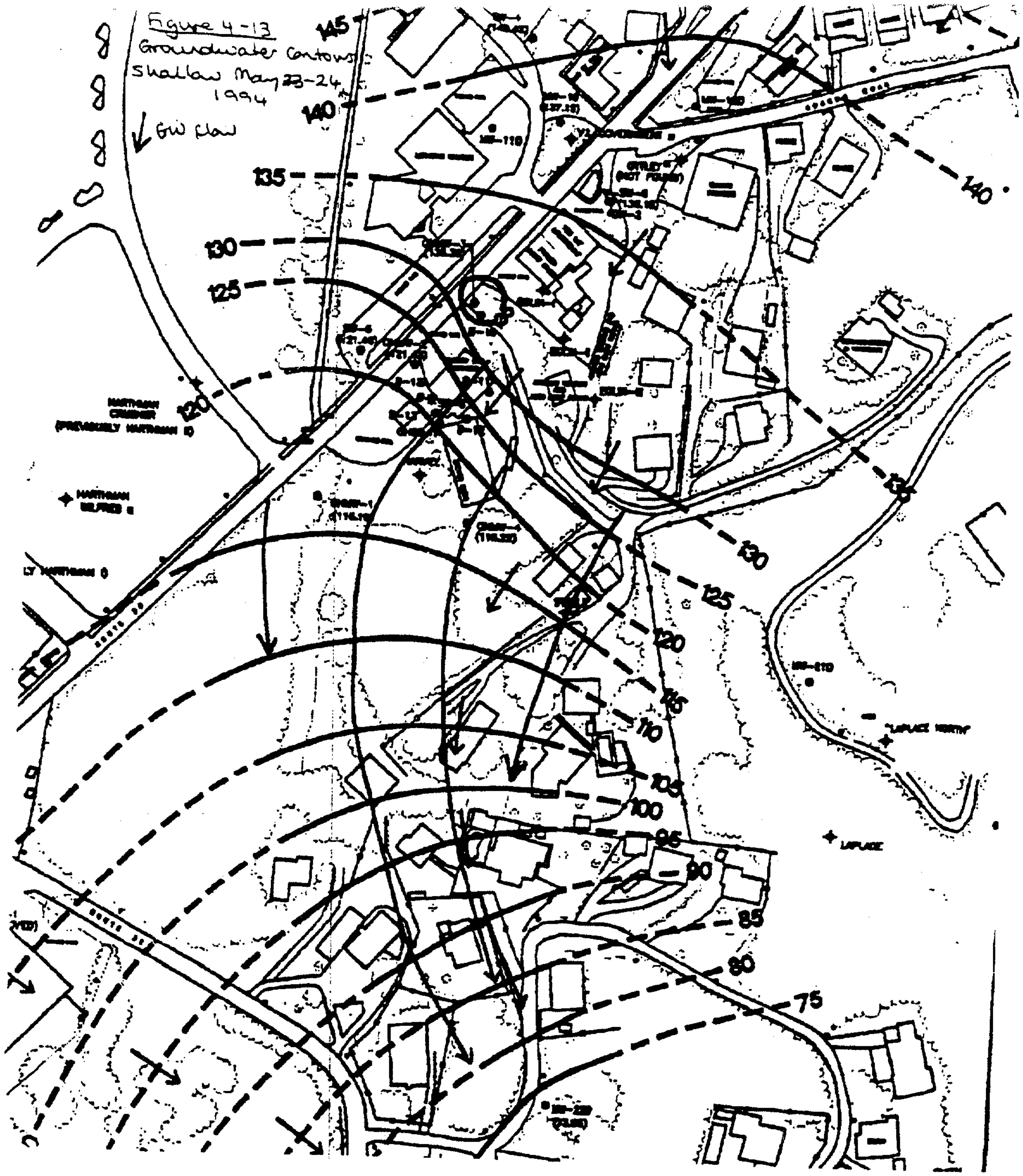
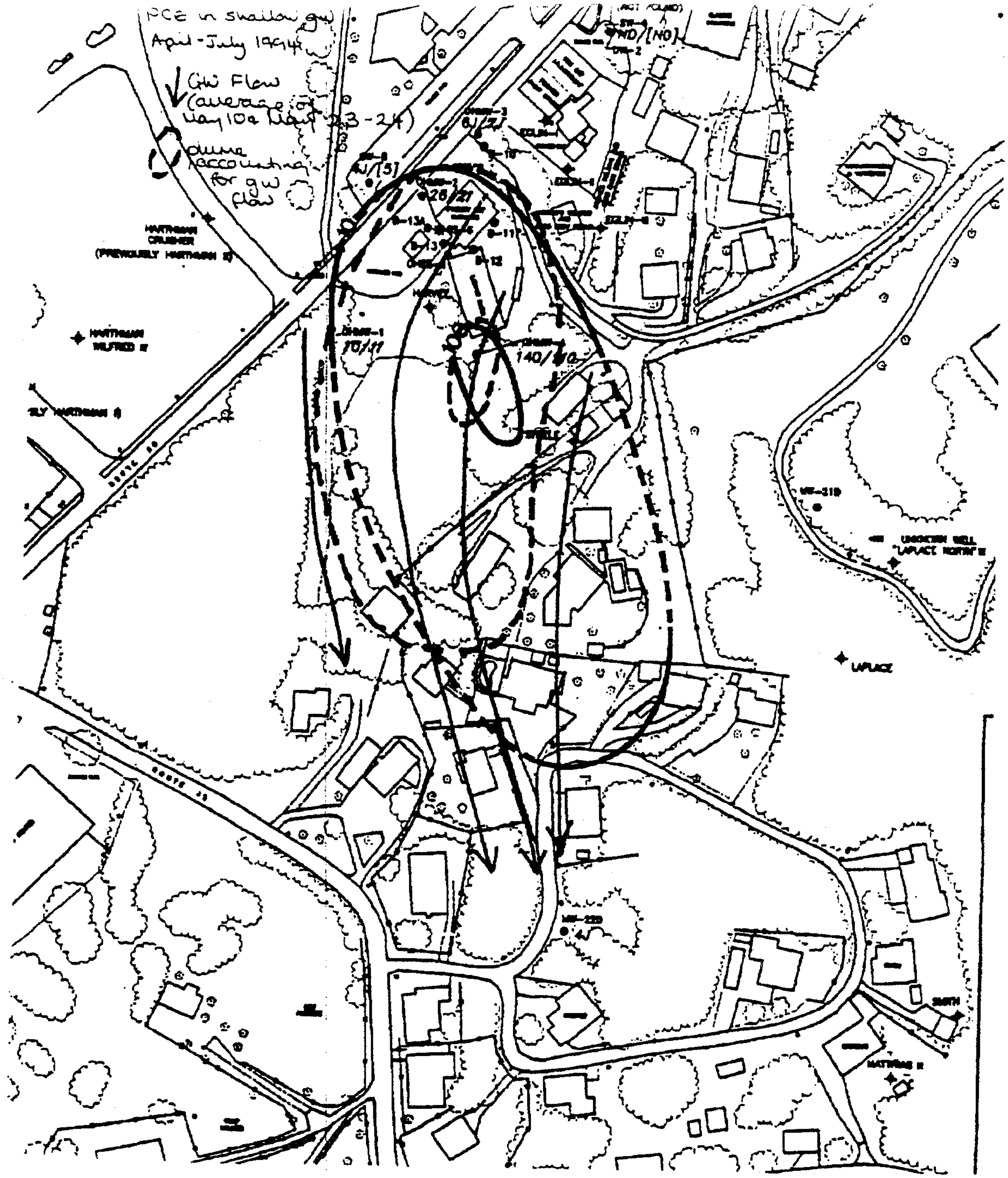


Figure 4-13
Groundwater Contours
Shallow May 23-24
1994
GW Flow
145
140
135
130
125
120
115
110
105
100
95
90
85
80
75
LAPLACE NORTH
LAPLACE


PCE in shallow gw
April-July 1994
GW Flow (average of May 10 & May 23-24)
plume accounting for gw flow
HARTMAN CRUSHER
LAPLACE

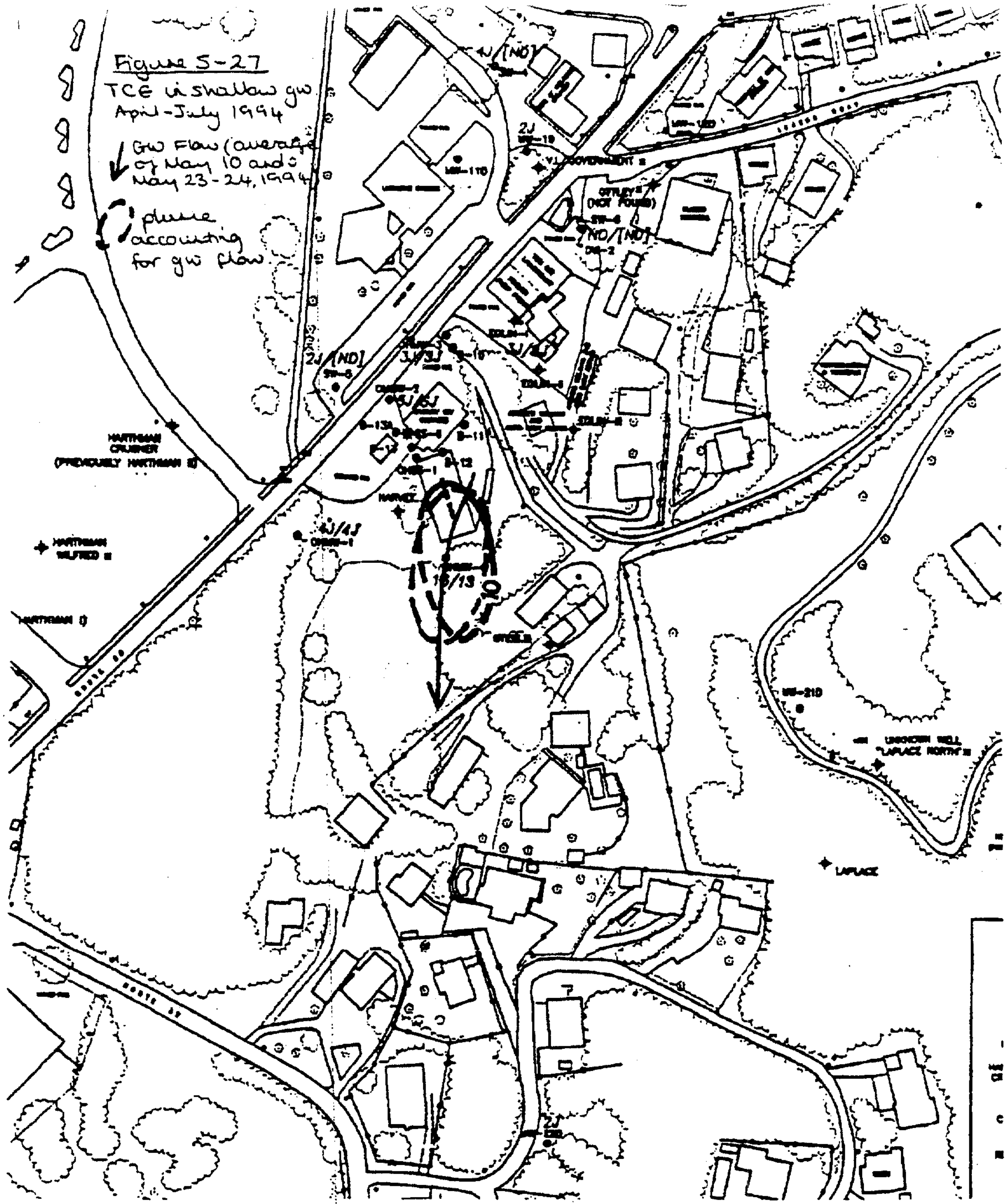
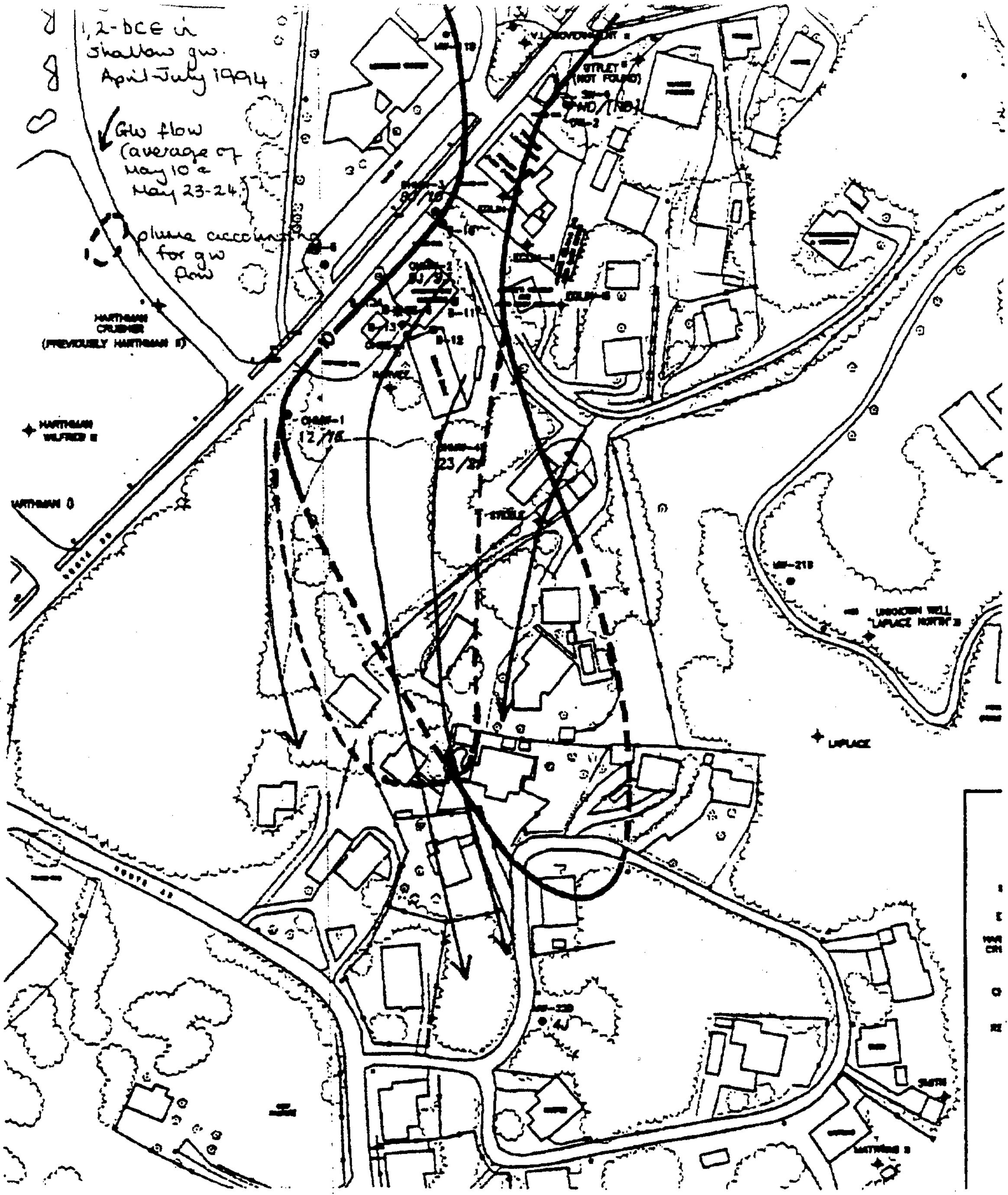
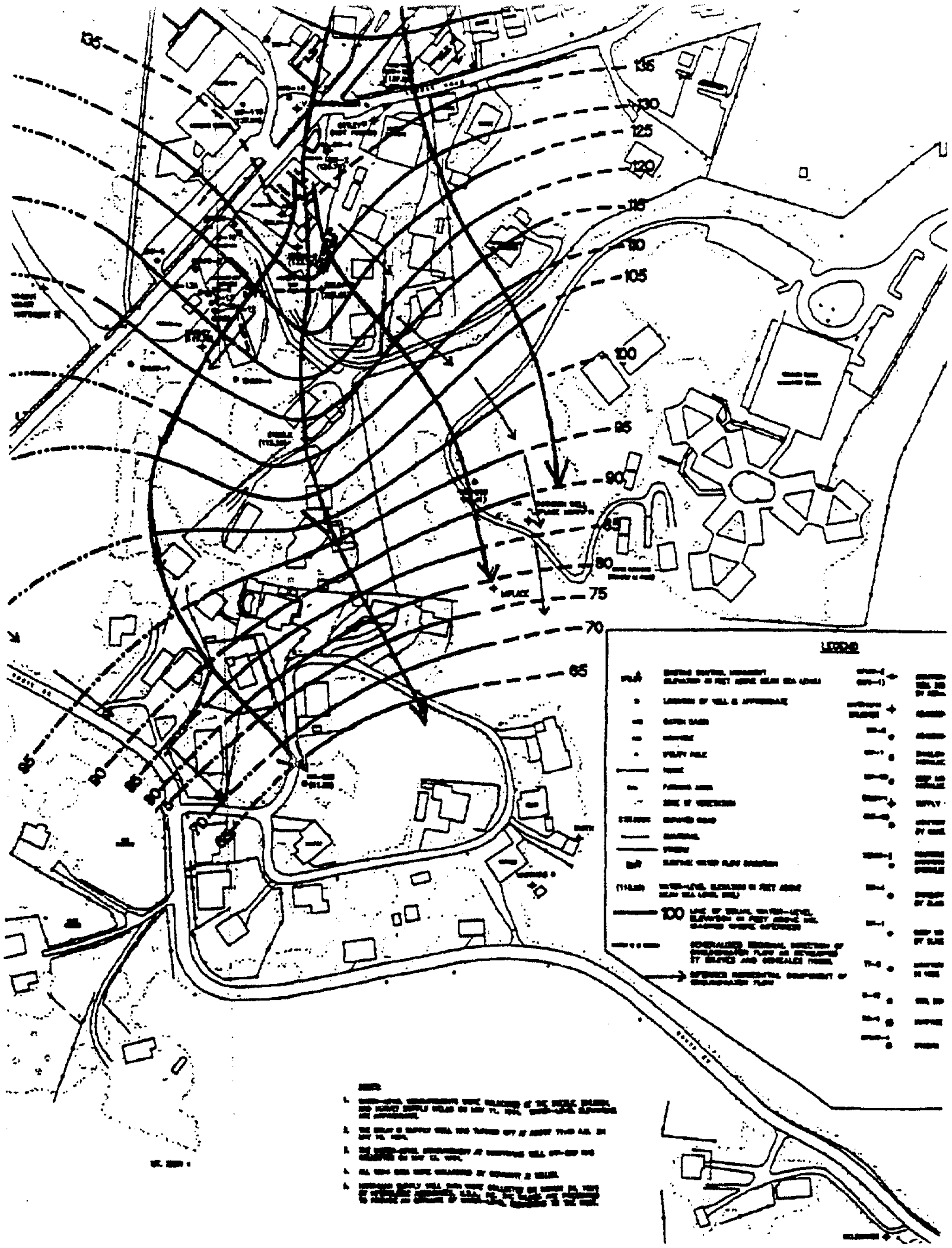
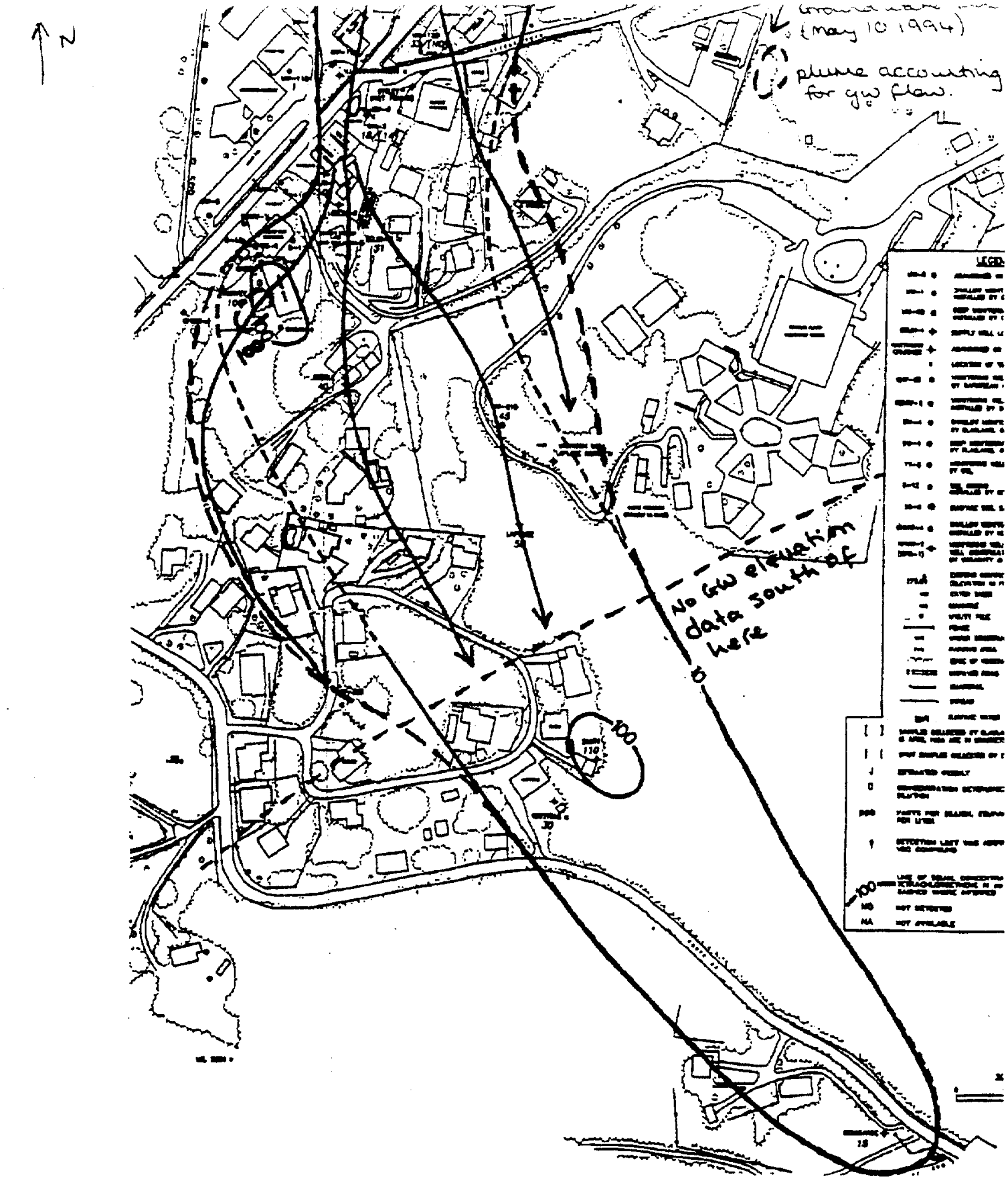
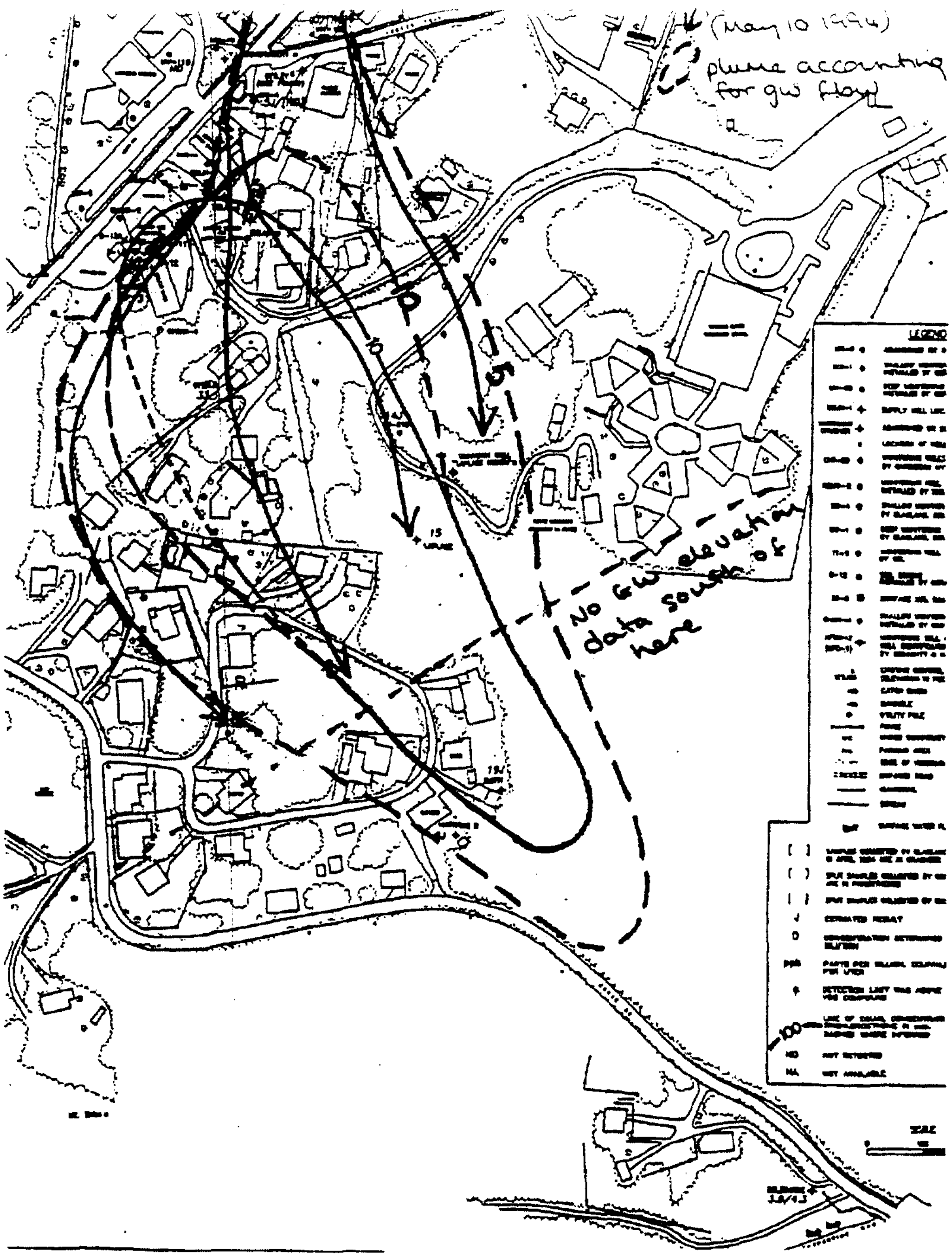


Figure 5-27
TCE in shallow gw
April-July 1994
GW Flow (average of May 10 and May 23-24, 1994)
plume accounting for gw flow
HARTHMAN CRUSHER (PREVIOUSLY HARTHMAN II)
HARTHMAN WILFRED II
HARTHMAN I
V.I. GOVERNMENT II
OTTLEY II (NOT FOUND)
ND/[ND]
2J [ND]
3J/3J
6J/6J
4J/4J
15/13
10
MW-210
UNKNOWN WELL "LAPLACE NORTH" II
LAPLACE


1,2-DCE in shallow gw. April-July 1994
GW flow (average of May 10 & May 23-24)
plume accounting for gw flow
HARTHMAN CRUSHER (PREVIOUSLY HARTHMAN 2)
HARTHMAN WILFRED 2
STYLET (NOT FOUND)
12/76
23/27
UNKNOWN WELL "LAPLACE NORTH" 2
LAPLACE
SMITH
MATTHEWS 2


135
130
125
120
115
110
105
100
95
90
85
80
75
70
65
LEGEND
100


N
(May 10 1994)
plume accounting for gw flow.
No GW elevation data south of here
100
100


(May 10 1994)
plume accounting for gw flow
No GW elevation data south of here
LEGEND

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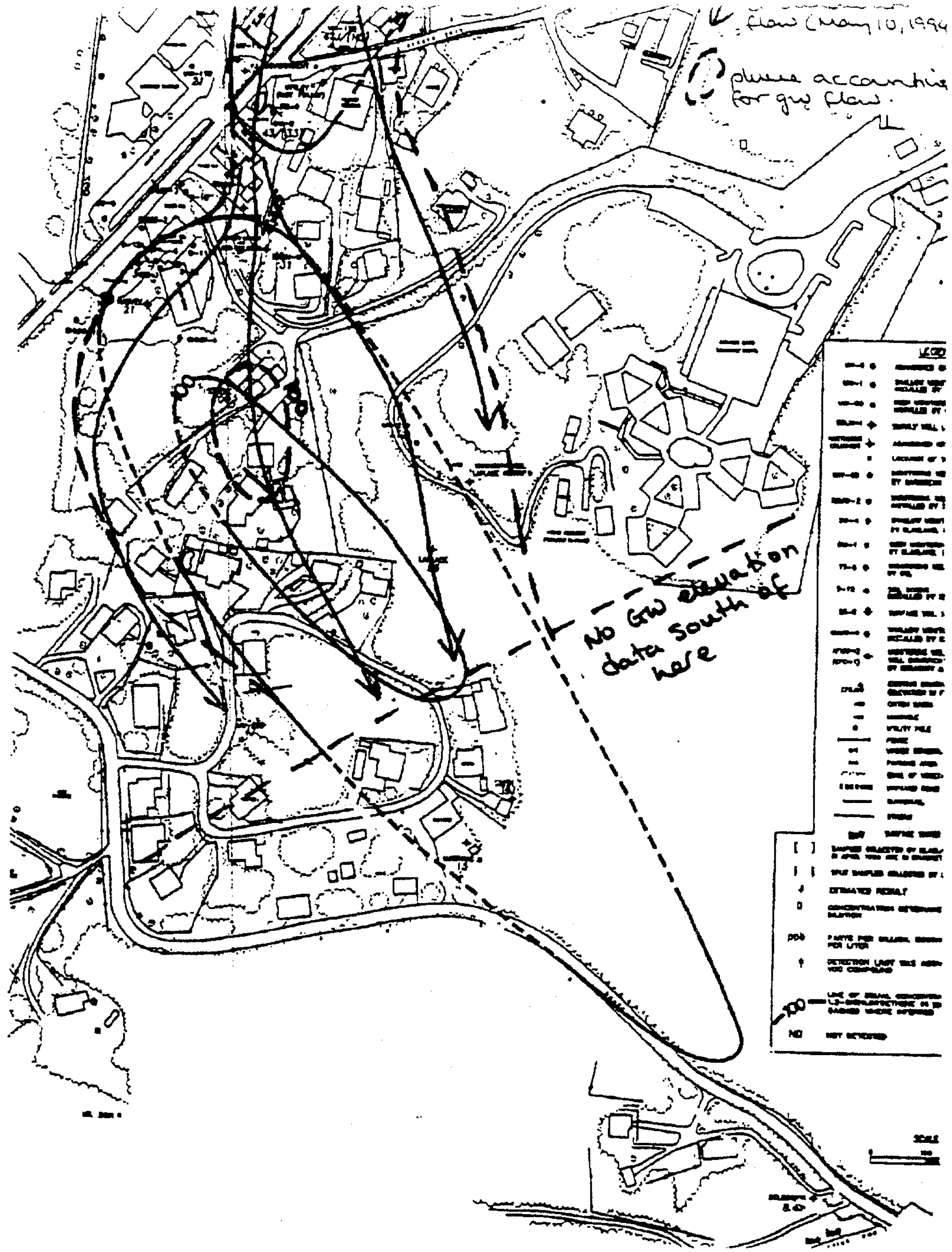

: flow (May 10, 1994
plume accounting for gw flow.
No GW elevation data south of here

NANCY D'ANNA
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March 12, 1996

By Telefax and Mail
(212) - 637 - 3966

EXPRESS MAIL

Caroline Kwan, Project Manager
New York/Caribbean Superfund Branch 2
U.S. EPA Region II
290 Broadway, 20th Floor
New York, New York 10007-1866

Re: **Comments on "Feasibility Study" and "Proposed Plan for Remediation", Tutu Well Site, St. Thomas, Virgin Islands**

Dear Ms. Kwan:

Enclosed are three copies of the comments prepared by my office on the above referenced documents. These comments are provided on behalf of my client, L'Henri, Inc. These comments are being transmitted to counsel for the members of the group of Potentially Responsible Parties. Please feel free to contact my office, if you have any questions concerning this matter.

Sincerely,

Nancy D'Anna

Nancy D'Anna, Esq.

ND/aw

COMMENTS ON FEASIBILITY STUDY AND PROPOSED PLAN FOR REMEDIATION TUTU WELL SITE, ST. THOMAS, UNITED STATES VIRGIN ISLANDS SUBMITTED ON BEHALF OF L'HENRI, INC.

I. General Comments

Upon review of the administrative record maintained for Tutu Well Site, St. Thomas, United States Virgin Islands, it is apparent, that International Technology Corporation, ("IT") on behalf of L'Henri, Inc. has previously submitted comments on the Report of the Remedial Investigation, (attached as Exhibit 1), the Draft Feasibility Study (attached as Exhibit 2) and the Comments of the United States Environmental Protection Agency on the Report prepared by IT of the Soil Remediation conducted at the O'Henry Dry Cleaners, (attached as Exhibit 3). There are basic conclusions reached in the forgoing documents which appear to be inconsistent with the data generated from the sampling at the Tutu Well Site. On behalf of L'Henri, Inc., IT has previously submitted comments on these inconsistencies. As set forth in more detail below, we again reiterate those comments previously submitted.

A. <u>The conclusion that L'Henri is the primary source of contamination of chlorinated compounds in the southern portion of the aquifer is not supported by the data concerning groundwater flow, or an accurate interpretation of the VOC plume</u>.

As stated previously, in the comments submitted by IT on behalf of L'Henri, Inc. the most appropriate depiction of the deep groundwater elevation contour map for the area down gradient from the O'Henry dry cleaning store is contained in the map drawn for data collected on May 10, 1994. This map is most appropriate because it contains data from the Steele, Harvey, Eglin II, and

Eglin III wells. As demonstrated on the May 10, 1994 map, deep groundwater, and consequently contaminants, would flow southwest, beneath the O'Henry dry cleaning store. The flow path from the O'Henry dry cleaning store does not pass through the location of the Steele or LaPlace wells. Shallow groundwater flow is generally southwesterly in the vicinity of O'Henry. **See, Exhibit 1, general comment 1 and attached depictions of the deep and shallow groundwater flow maps), Exhibit 2 Comment on Section 2.1.1.3.**

The presentation of the TCE, PCE, AND 1,2 DCE in the deep groundwater is not consistent with the appropriate deep groundwater flow map as presented in the Report of the Remedial Investigation. A more consistent depiction of the plumes was submitted by IT with the comments on the Report of the Remedial Investigation. **See, Exhibit 1, comment 2 and attached maps.**

In addition, as stated in the Feasibility Study and Proposed Action Plan, 1,2 DCE is present in the southern portion of the aquifer at the level of 100 ppb. 1,2 DCE contamination is not present in the soil at the O'Henry Dry Cleaning Store at significant levels.

B. <u>The significance of the Esso Tutu Service Station as a source of contamination in the southern portion of the aquifer is ignored.</u>

The accurate depiction of groundwater flow lines demonstrates that the majority of the contamination which is present in the southern portion of the aquifer could not originate at the O'Henry Dry Cleaners, assuming that groundwater flow direction has not significantly changed with time. Additional evidence for this position is found in examination of the presence of MTBE contamination in the aquifer. MTBE is a gasoline additive, and is not used in any form in the dry cleaning process. MTBE is found in the deep groundwater south of the Tutu Texaco Station, past the Esso Tutu Service Station, to the Delegarde well.

Further, it is without question, that the former operator of the Esso Tutu Service Station emptied the holding tank which contained waste oil, heavily contaminated with chlorinated hydrocarbons by pumping the tank into the toilet, which emptied directly into the sanitary sewer. In spite of this evidence of improper disposal and the obvious potential that the sanitary sewer remains as a potential source of chlorinated contamination, this potential source has not been investigated. **See, Soil Tech, 1990; Exhibit 1, comment 5.** Moreover, chlorinated hydrocarbon contamination has been detected in the sanitary sewer and soil at the Esso Tutu Service Station.

Further, there is a PCE hot spot located in the area identified as the "northern plume". This area, and its potential source has been ignored. In addition, if the accurate direction of groundwater is considered, it is impossible for a direct flow path to extend from the Harvey Supply Well to the Smith Supply Well. **See, Exhibit 1, comment 1, and attached maps.**

C. <u>The actual evidence obtained during the remediation of the soil at the O'Henry Dry Cleaning Store demonstrates that DNAPL contamination is not present in the soil.</u>

The Report on the Remedial Investigation stated that the concentration of PCE in the soil was not high enough to conclude the PCE was present in a separate phase in the soil. This conclusion is supported by the actual data collected during the soil remediation conducted by L'Henri, Inc. at the O'Henry store. The actual soil data collected demonstrates that chlorinated contamination is not present at a depth below six feet at O'Henry. Further, the presence of DNAPL at the site has been assumed based upon the presence of PCE in OHMW4, a well which is located side gradient, and not down gradient from O'Henry, and the historical use of PCE at the dry cleaning store. **See, exhibit 2, comments Section 2.2.2.1.**

II. Soil Remediation at the O'Henry Dry Cleaners.

The soil remediation alternatives provided in the proposed action plan do not take into consideration that remediation has already occurred at O'Henry with EPA approval and oversite. Further, the cleanup standards provided by EPA have been incorrectly calculated. Site modeling utilized by EPA does not take into account all site specific data available. However, without conceding that said modeling is appropriate, utilizing the method of calculation provided by EPA, with appropriate site specific data, the cleanup standard to be used at the O'Henry site would be 534 mg/kg for soil above 1.6 feet and 713 mg/kg for soil below 1.6 feet, not 31 ppb. **See, Exhibit 4.**

III. Groundwater Remediation at the Tutu Well Site.

Initially, we note, that prior to Hurricane Marilyn, the Virgin Islands had experienced a drought with lasted in excess of two years. During this period, most of the groundwater elevation data was collected. During and following Hurricane Marilyn, rainfall has increased dramatically. In St. Croix, IT has observed that groundwater elevation increased a much as ten feet, in one aquifer after the huricane. Consequently, it is possible that the location of the groundwater contamination plumes have shifted.

Further, there is no basis in the administrative record to assume that clean up to groundwater standards through the decommissioning of existing wells, installation of groundwater recovery wells will be cost effective or will result in restoration of the groundwater to drinking water standards. The pumping of groundwater in the Tutu valley has operated to stabilize the plume and to prevent the downward migration of the plumes in the prior years. Utilization of existing wells may be more effective than the method proposed by EPA. Moreover, there has been no consideration of the time period required to restore the aquifer through the efforts of pumping and treating the groundwater, as compared to natural attenuation. The additional technical comments concerning the groundwater treatment system were contained in the comments submitted by IT to the draft Feasibility Study and are reiterated herein. Said comments are attached as Exhibit 3 for your convenience.

March 10, 1996

Ms. Caroline Kwan
Remedial Project Manager
U. S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, New York 10007-1866

Dear Ms. C. Kwan:

Thanks for the opportunity to review the Proposed Plan and to provide comments made at the public hearing on March 5, 1996.

My principal concern is that the document summarizing the Proposed Plan on which the public in Tutu was expected to provide input on was written in a foreign language. The low public participation at the hearing on March 5, 1996 and previous hearings I feel can be partly attributed to this. I am confident that you as well as I sincerely believe that true success of any actions at this Superfund site is greatly dependant and enhanced by participation from the affected population. While it may be too late to translate this document in to language that the bulk of the population can comprehend I advise you that no remediation alternative can be properly implemented unless there is communication to the persons affected in language that they can understand. An effective public information program is vital to whatever remediation alternative is selected. Having said all this though, I confess that I am fully aware of the difficulties of effectively presenting this material in a form understandable to the general public.

In my work at the Virgin Islands Water Resources Research Institute, we consider public participation to be critical and I know how difficult it is to obtain. I also am aware of efforts made by your office to secure public input. These efforts though need to be expanded. Given the enormity of the Tutu aquifer problem and the effect that it can have on people's lives a it would be appropriate that a comprehensive information program be included in the cleanup. This should be more than just reliance on

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FAX: (809) 693-1074

volunteers as was mentioned in the hearing.

Also, I urge that the introduction of treated water directly in to the Tutu water distribution systems be well researched. I am fully aware of the need to use all available water and also I know that this practice might have been followed elsewhere. However, in the instant situation where the affected community is smaller than most, the technical awareness and confidence in water treatment processes low, public acceptance of this alternative at the implementation is not assured.

My comments are intended to help you in your efforts and I hope that they will be accepted as such. At the Water Resources Research Institute of the University of the Virgin Islands we are as concerned as you are about the risks to public health caused by the contamination of this aquifer and applaud your efforts. We encourage you to not look as public participation as only a responsibility dictated by CERCLA but rather an essential component of any remedial alternative that will provide for maximum protection of the environment and human health. If we can be of any assistance to you, please do not hesitate to call on us.

The University's Eastern Caribbean Center and the WRRI have committed themselves to working with the Tutu community the minimize the effects of the water contamination problem. We urged community groups to have members participate in the March 5 hearing and have applied for an Environmental Justice grant to enable us to work formally with community based groups to transfer information and develop skills and confidence to actively participate in resolving the problem. We would welcome any suggestions you may have and look forward to working with you in the future.

Sincerely,

Henry H. Smith, Ph.D.
Director